THE NATIONAL PLUMBING CODE

ILLUSTRATED

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National Plumbing Code—Illustrated

Based on 1951 Report of the Coordinating Committee for a National Plumbing Code

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FOREWORD

This book is designed to fill a need for illustrative interpretation of the National Plumbing Code. Since its publication in 1951, the Report of the Coordinating Committee for a National Plumbing Code has been widely studied and discussed by people concerned with plumbing standards. Already, more than 200 states and municipalities have adopted it as a guide in revising their codes, or in writing new codes. It is likely that more and more communities will become interested in it as they consider revision of their local codes. In fact, the code is beginning to fulfill the function which its sponsors intended — a national standard; a means of approaching uniformity on the basis of standards reflecting up-to-date scientific research.

Because the code is new, yet being used extensively, questions of interpretation are constantly arising. It is hoped that this book, through graphic presentation, will answer many such questions. Its content and arrangement has been devised to be helpful to architects, engineers, manufacturers, city officials, plumbing contractors, inspectors and journeymen.

The method of presentation is to quote the actual language of specific sections of the code which have been selected for illustration. Following the quoted portions, where necessary, interpretive text appears in larger type under the heading, "Note." Generally, this interpretive material amplifies and describes the accompanying illustration.

As executive secretary of the Coordinating Committee for a National Plumbing Code, the author is greatly indebted to all the members of the committee for their collaboration in producing the code. The work of drafting the code continued from 1945 to 1951, necessitating field research, National Bureau of Standards laboratory tests and project inspections. The combined knowledge of the committee members covered the entire field of the plumbing industry. Obviously this book, illustrating the code, reflects not only the author's ideas, but the extensive discussions which preceded agreement of committee members on the language and terms employed in the code.

DEFINITIONS

The definitions in the National Plumbing Code cover the trade terms most widely used by master plumbers and journeymen plumbers. These trade terms are also spreading in use among architects, engineers, and others whose business interests are allied with the plumbing industry. It is hoped that the following illustrations will help to further the trend of a common language among those concerned in the plumbing industry.

BUILDING DRAIN—The building (house) drain is that part of the lowest piping of a drainage system which receives the discharge from soil, waste and other drainage pipes inside the walls of the building and conveys it to the building (house) sewer beginning 3 feet outside the building wall. [See Fig. 1.]

BUILDING SEWER—The building (house) sewer is that part of the horizontal piping of a drainage system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to a public sewer, private sewer, individual sewage-disposal system or other point of disposal. [See Fig. 1.]

NOTE: Fig. 1 illustrates a building drain extending 3 feet beyond the building wall to the house sewer. Most local codes require that the house drain extend at least 3 feet beyond the building wall, but some local requirements range from 2 feet to 10 feet.

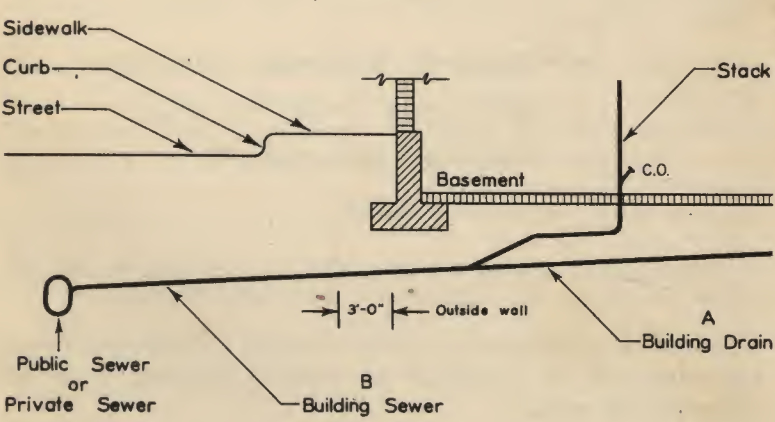


Fig. 1

BUILDING SUBDRAIN—A building (house) subdrain is that portion of a drainage system which cannot drain by gravity into the building sewer. [See Fig. 2.]

NOTE: The waste from a subdrain is collected by gravity into a sump or ejector, then either is discharged by mechanical means directly into the building drain, or is carried separately to the building sewer. A subdrain should not be confused with a subsoil drain.

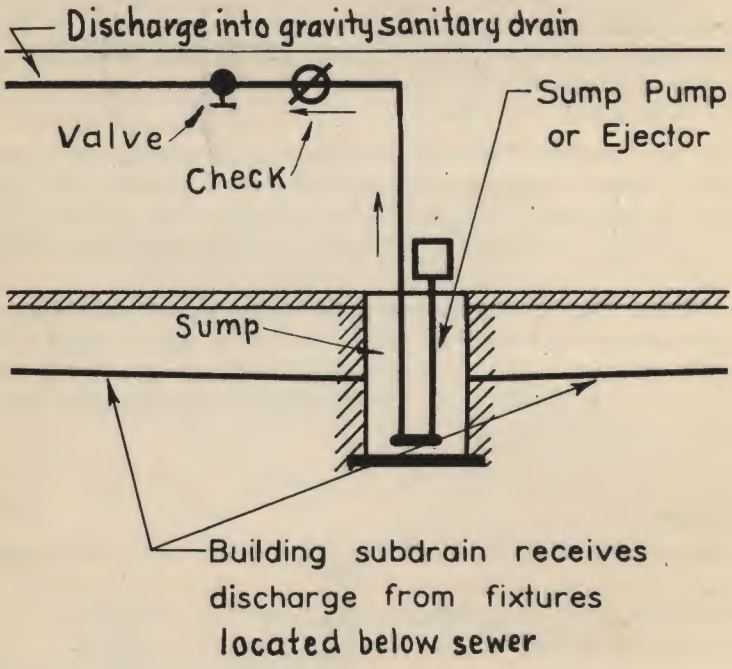


Fig. 2

SUBSOIL DRAIN—A subsoil drain is a drain which receives only subsurface or seepage water and conveys it to a place of disposal.

NOTE: A building subsoil drain usually is installed around the perimeter of a building or under a building to collect underground water.

BUILDING TRAP—A building (house) trap is a device, fitting or assembly of fittings installed in the building drain to prevent circulation of air between the drainage system of the building and the building sewer. [See Fig. 3.]

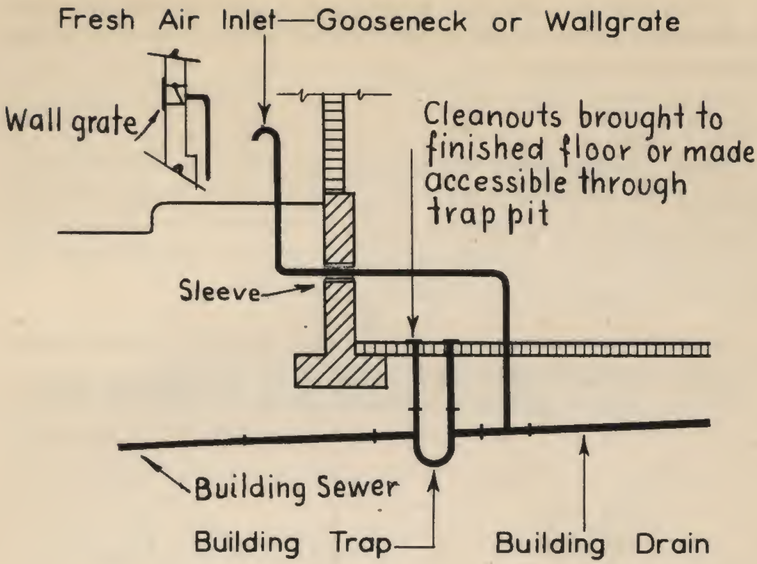


Fig. 3

FIXTURE-UNIT—A fixture-unit is a quantity in terms of which the load-producing effects on the plumbing system of different kinds of plumbing fixtures are expressed on some arbitrarily chosen scale.

NOTE: See tables 11.5.2 and 11.5.3 for fixture-units of drainage system, and chart D.2 for the water supply system.

For further explanation, read "Fixture Unit Ratings as Used in Plumbing System Designs," written by Herbert N. Eaton and John L. French, Housing Research paper 15, Housing & Home Finance Agency. See bibliography.

FIXTURE-UNIT FLOW RATE—Fixture-unit flow rate is the total discharge flow in gpm of a single fixture divided by 7.5, which provides the flow rate of that particular plumbing fixture as a unit of flow. Fixtures are rated as multiples of this unit of flow.

NOTE: Laboratory tests have shown that the rate of discharge of an ordinary lavatory with a nominal 1¼-inch outlet, trap, and waste is about 7.5 gallons per minute. This figure is so near to 1 cubic foot per minute that "1 cubic foot per minute" has become the accepted flow rate of one fixture-unit. This flow rate is used when planning drainage designs of fixtures not already rated in table 11.4.2.

LOAD FACTOR—Load factor is the percentage of the total connected fixture-unit flow rate which is likely to occur at any point in the drainage system. It varies with the type of occupancy, the total flow unit above this point being considered, and with the probability factor of simultaneous use.

NOTE: Load factor represents the ratio of the probable load to the potential load. It is determined by the average rates of flow of the various kinds of fixtures, by the average frequency of use, by the duration of flow during one use, and by the number of fixtures installed.

COMMON VENT—A common vent is a vent connecting at the junction of 2 fixture drains and serving as a vent for both fixtures.

NOTE: Fig. 4 illustrates several types of common vent.

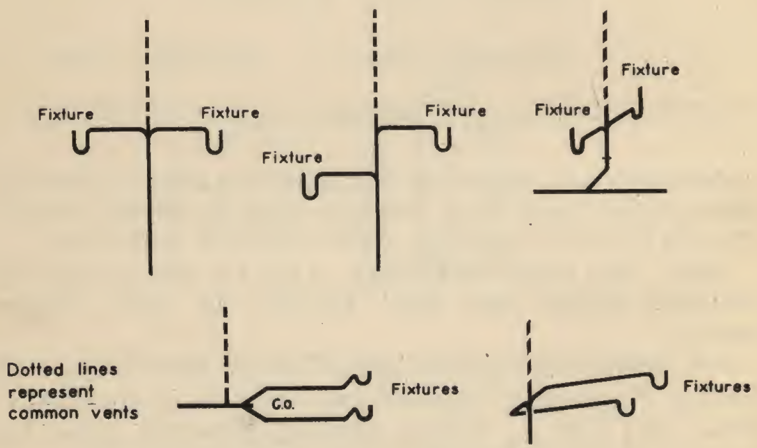


Fig. 4

CONTINUOUS VENT—A continuous vent is a vertical vent that is a continuation of the drain to which it connects.

NOTE: The drain may be either vertical or horizontal. (Fig. 5.) The vent must be vertical and a continuation of the drain. There are many ways in which a continuous vent may be installed. A continuous vent is also known as a back vent or an individual vent.

FIXTURE BRANCH—A fixture branch is a pipe connecting several fixtures. [See Fig. 6.]

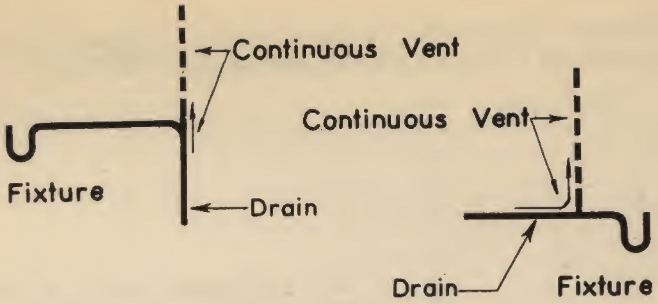


Fig. 5

FIXTURE DRAIN—A fixture drain is the drain from the trap of a fixture to the junction of that drain with any other drain pipe. [See Fig. 6.]

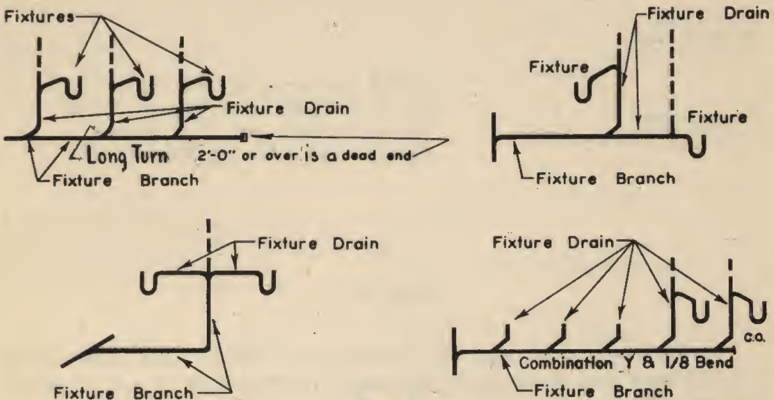
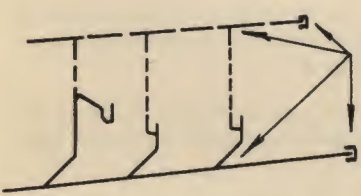


Fig. 6

DEAD END—A dead end [Fig. 7] is a branch leading from a soil, waste or vent pipe, building drain, or building sewer, which is terminated at a developed distance of 2 feet or more by means of a plug or other closed fitting.



A dead end is a capped or plugged pipe extension longer than two feet, beginning the measurement at the end of the last fitting of a soil, waste, or vent pipe.

Fig. 7

Developed length—The developed length of a pipe is its length along the center line of the pipe and fittings. [See Fig 7a.]

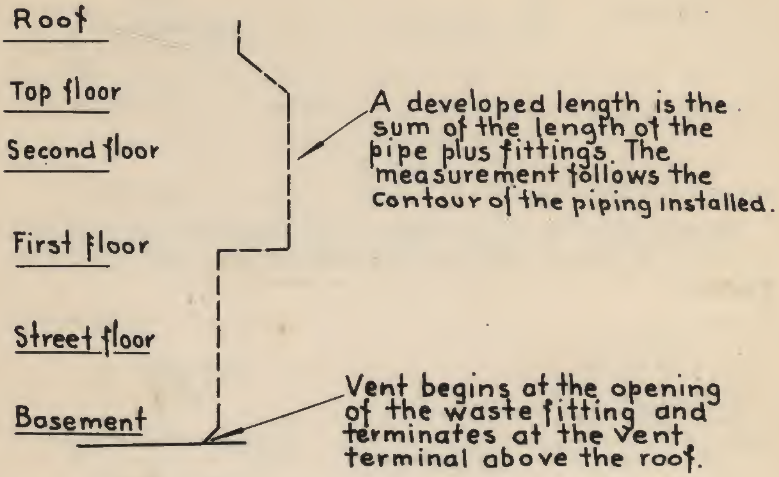


Fig. 7a

Loop vent—A loop vent is the same as a circuit vent except that it loops back and connects with a stack vent instead of a vent stack. [See Fig. 8.]

Horizontal branch—A horizontal branch [Fig. 8] is a drain pipe extending laterally from a soil or waste stack or building drain, with or without vertical sections or branches, which receives the discharge from one or more fixture drains and conducts it to the soil or waste stack or to the building (house) drain.

Horizontal pipe—A horizontal pipe is any pipe or fitting which is installed in a horizontal position or which makes an angle of less than 45 degrees with the horizontal. [See Fig. 9.]

Vertical pipe—A vertical pipe is any pipe or fitting which is installed in a vertical position or which makes an angle of not more than 45 degrees with the vertical. [See Fig. 9.]

Flush valve—A flush valve is a device located at the bottom of the tank for the purpose of flushing water closets and similar fixtures. [See Fig. 10.]

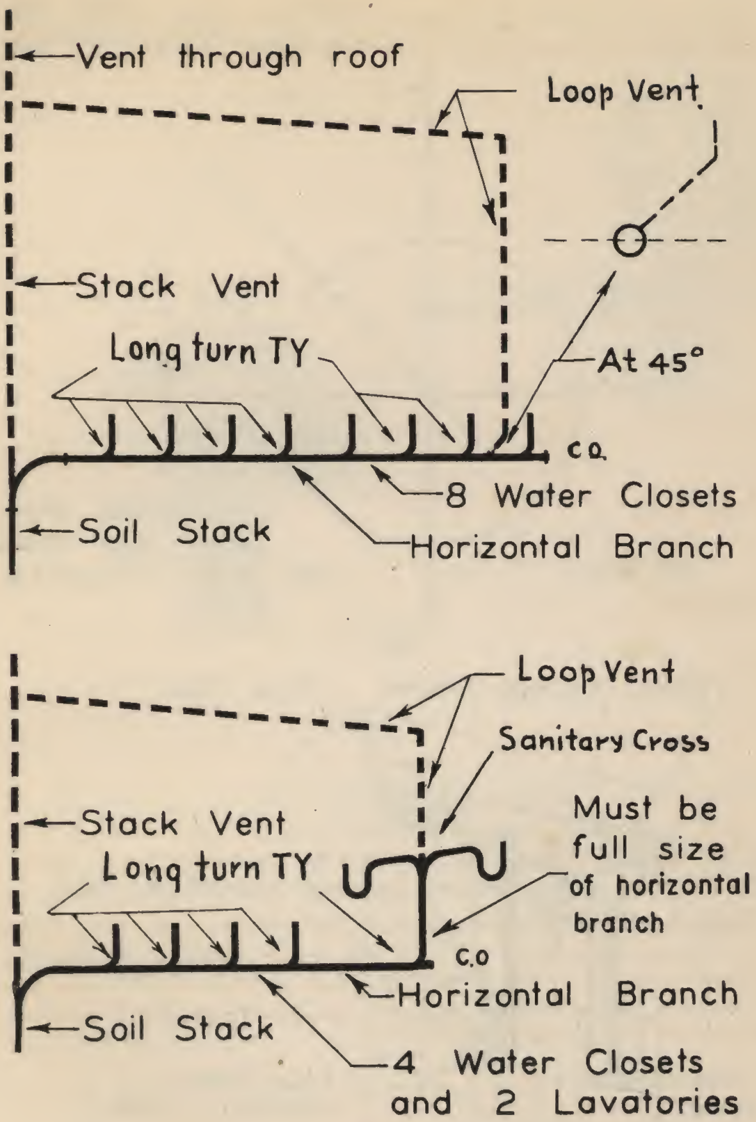


Fig. 8

FLUSHOMETER VALVE—A flushometer valve is a device which discharges a predetermined quantity of water to fixtures for flushing purpose and is actuated by direct water presure. [See Fig. 11.]

NOTE: Fig. 11 illustrates a flushometer valve.

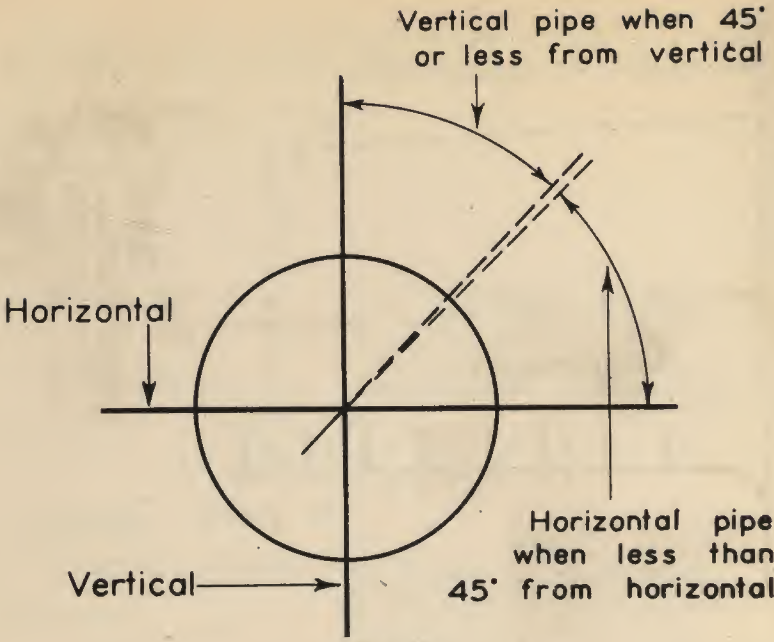

Vertical pipe when 45° or less from vertical
Horizontal
Vertical
Horizontal pipe when less than 45° from horizontal

Fig. 9

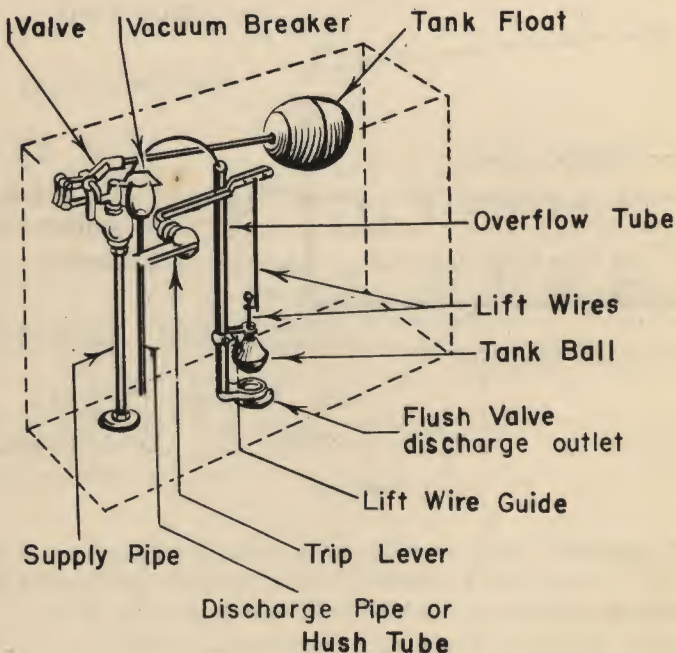

Valve
Vacuum Breaker
Tank Float
Overflow Tube
Lift Wires
Tank Ball
Flush Valve discharge outlet
Lift Wire Guide
Supply Pipe
Trip Lever
Discharge Pipe or Hush Tube

Fig. 10

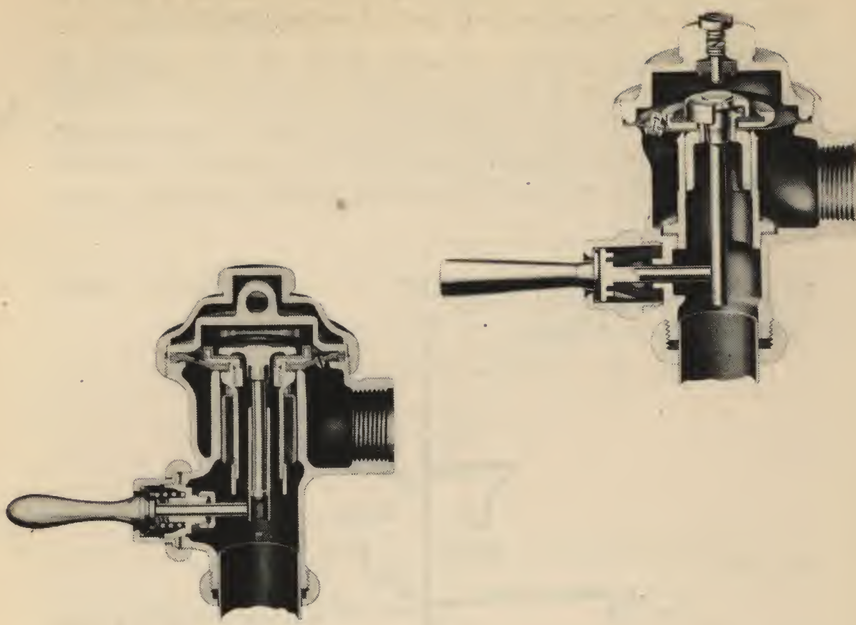


Fig. 11

WET VENT—A wet vent is a vent which receives the discharge from wastes other than water closets.

NOTE: A wet vent also serves as a waste, but is limited to low rated fixtures (not more than 3 fixture-units each) and the wet vent is loaded only to half of its capacity. [See Fig. 12.]

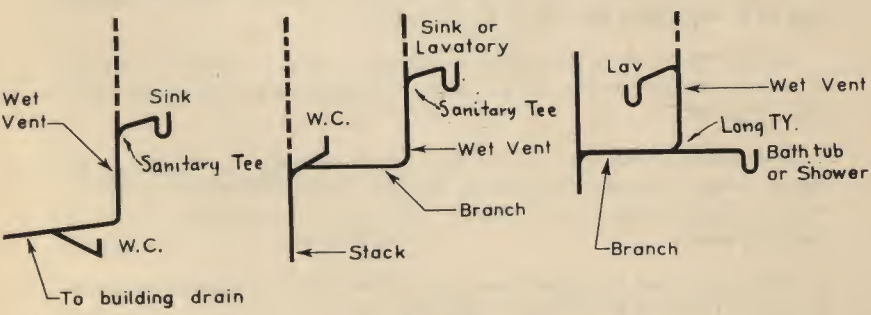


Fig. 12

STACK VENTING—Stack venting is a method of venting a fixture or fixtures through the soil or waste stack. [See paragraph 12.13.]

NOTE: Stack venting, in some parts of the country, is called stack group or stack grouping. It means the location of plumbing fixtures in relation to the stack in such manner that each fixture connects separately to the stack, thereby eliminating the need of individual venting in most cases. (See Fig. 13.)

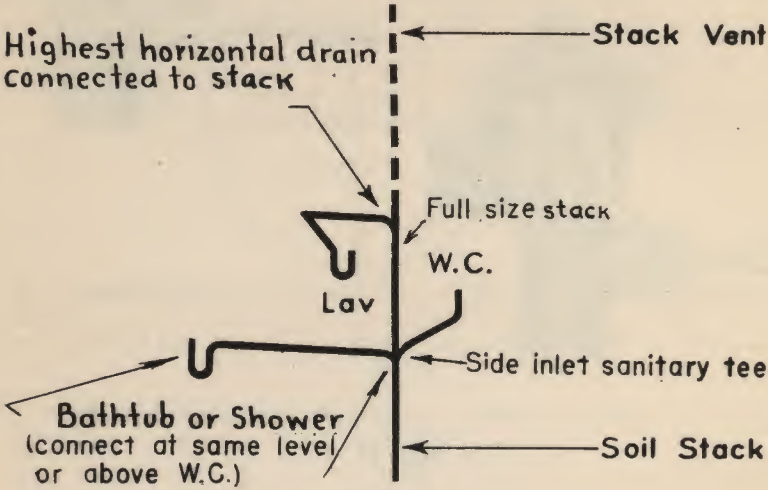


Fig. 13

STACK VENT—A stack vent is the extension of a soil or waste stack above the highest horizontal drain connected to the stack. It is sometimes called a waste vent or soil vent. [See Fig. 14.]

CIRCUIT VENT—A circuit vent [Fig. 14] is a branch vent that serves 2 or more traps and extends from in front of the last fixture connection of a horizontal branch to the vent stack.

RELIEF VENT—A relief vent is a vent the primary function of which is to provide circulation of air between drainage and vent systems. [See Fig. 14.]

SOIL PIPE—A soil pipe is any pipe which conveys the discharge of water closets, urinals or fixtures having similar functions, with or without the discharge from other fixtures, to the building drain or building sewer.

VENT STACK—A vent stack is a vertical vent pipe installed primarily for the purpose of providing circulation of air to and from any part of the drainage system. [See Fig. 14.]

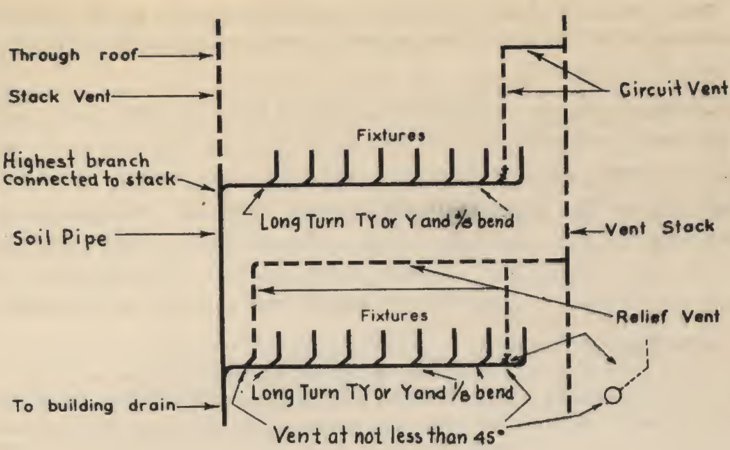


Fig. 14

TRAP—A trap is a fitting or device so designed and constructed as to provide, when properly vented, a liquid seal which will prevent the back passage of air without materially affecting the flow of sewage or waste water through it.

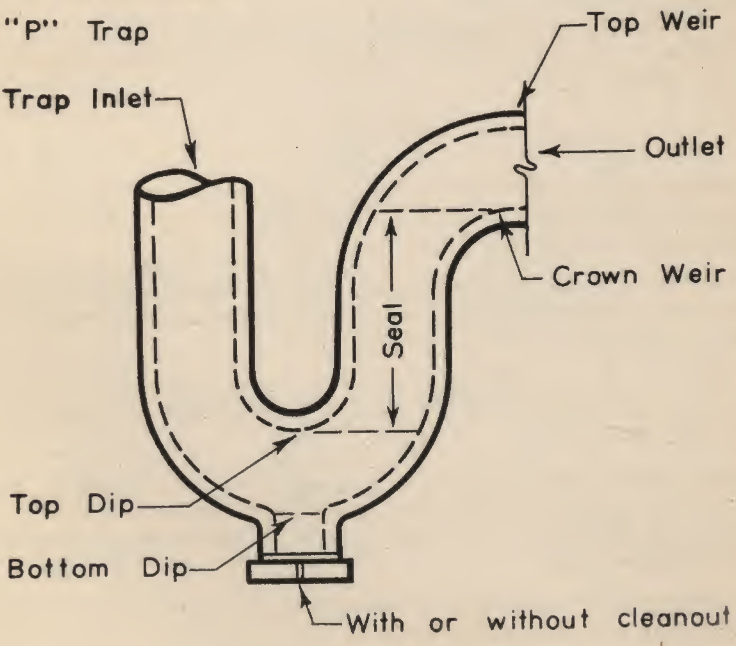


Fig. 15

TRAP SEAL—The trap seal is the maximum vertical depth of liquid that a trap will retain, measured between the crown weir and the top of the dip of the trap.

NOTE: Fig. 15 illustrates a P-trap with 2" trap seal. The trap seal is measured between the top of the dip and the crown weir. The water must reach the top of the dip of the trap in order to prevent odors and vermin from entering the house. The trap seal may even suffer a water loss as much as 1 inch, but it still remains an effective seal so long as there is a 1-inch seal above the top dip of the trap.

COMBINATION WASTE AND VENT SYSTEM—A combination waste and vent system is a specially designed system of waste piping embodying the horizontal wet venting of one or more sinks or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain. [See Figs. 161, 162, 163.]

GENERAL REGULATIONS

2.3 CHANGE IN DIRECTION.

2.3.2 *Short sweeps*—Short sweeps not less than 3 inches in diameter may be used in soil and waste lines where the change in direction of flow is from either the horizontal to the vertical or from the vertical to the horizontal and may be used for making necessary offsets between the ceiling and the next floor above.

NOTE: Fig. 16 illustrates a cast iron soil pipe quarter bend, a short sweep, and a long sweep; and a drainage recessed short turn elbow, a long turn elbow, and an extra-long turn elbow. These are used for changing direction of drainage piping as follows:

From	*To*	*Diameter of pipe*	*Install*
Vertical	Horizontal	3-inch and larger	A short sweep, or a 90-degree long turn drainage elbow
Horizontal	Vertical	3-inch and larger	A quarter bend, or a 90-degree short turn fitting
Vertical	Horizontal	Less than 3-inch	A long sweep, or an extra-long turn elbow
Horizontal	Vertical	Less than 3-inch	A quarter bend, or a 90-degree short turn fitting
For venting in any direction........................			A quarter bend, or a 90-degree short turn fitting

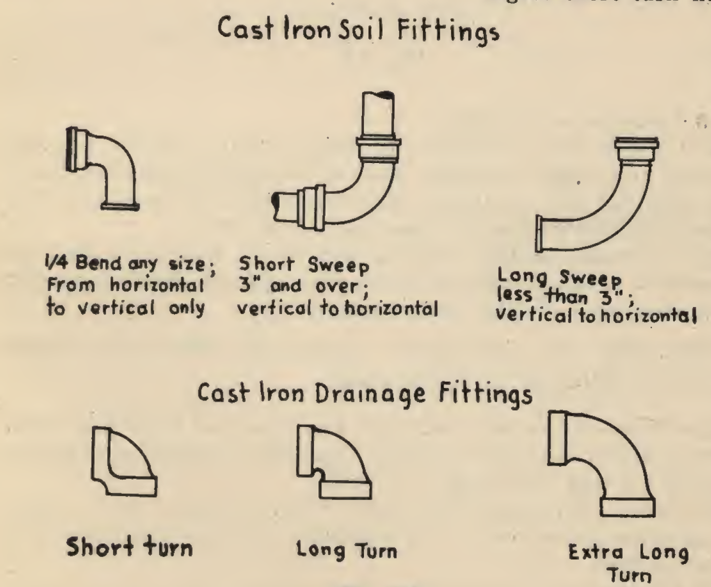


Fig. 16

2.4 Fittings and connections.

2.4.2 *Heel or side-inlet bend*—A heel or side-inlet quarter bend shall not be used as a vent when the inlet is placed in a horizontal position. [See Fig. 17.]

Note: When intended for service as a vent, but installed incorrectly, a heel or side-inlet of a quarter bend soon becomes clogged. The correct positions for service as a vent are:

When using a side-inlet quarter bend: Side inlet upright; full-size hub horizontal.

When using a high-heel inlet; Heel upright, or full-size hub upright.

When using a low-heel inlet: Heel upright.

All side inlets may be used as branch waste connections in any position.

Quarter Bends

Fig. 17

2.23 Location of fixtures.

2.23.1 *Light and ventilation*—Plumbing fixtures, except drinking fountains and single lavatories, shall be located in compartments or rooms provided with ventilation and illumination conforming to recognized published standards. [See ASA A53.1 1946.]

2.23.2 *Improper location*—Piping, fixtures, or equipment shall not be located in such a manner as to interfere with the normal operation of windows, doors, or other exit openings.

Note: Fig. 18 illustrates suggested clearances under various installation circumstances.

2.27.1 *Lead*—Three-inch lead bends and stubs may be used on water closets or similar connections, provided the inlet is dressed or expanded to receive a 4-inch floor flange.

2.27.2 *Iron*—Three-inch bends may be used on water closets or similar connections, provided a 4- by 3-inch floor flange is used to receive the fixture horn.

2.27.3 *Reducing*—Four- by three-inch reducing bends are permitted.

Note: The present trend is to standardize the use of 3-inch floor flanges by manufacturing water closets with a

horn short enough to permit installation of a 3-inch floor flange.

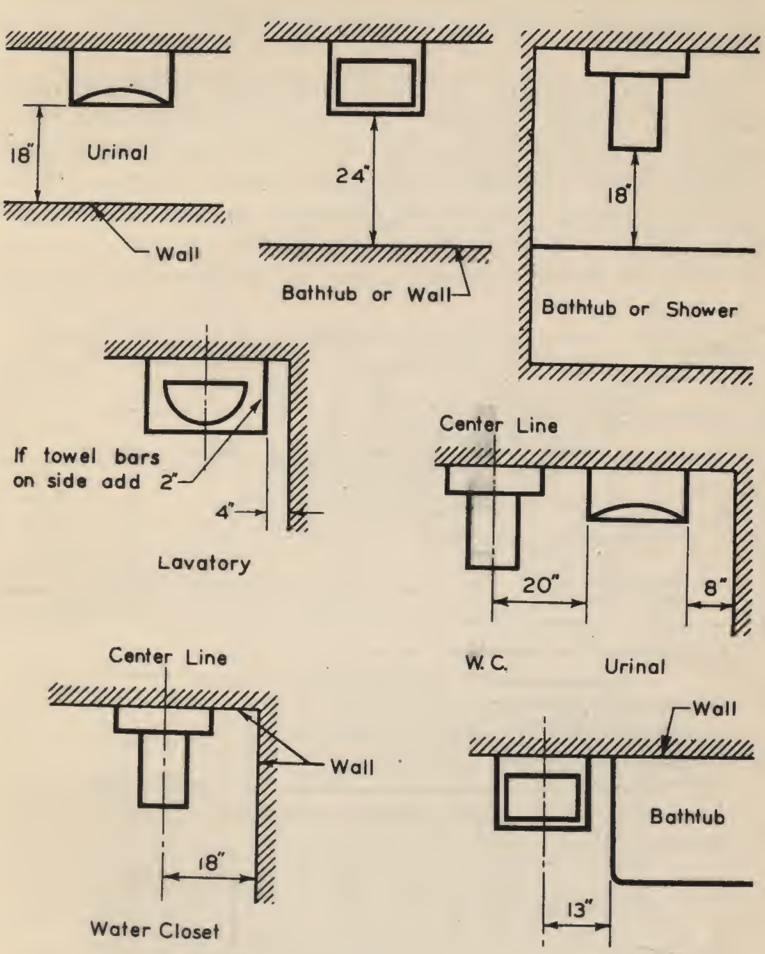


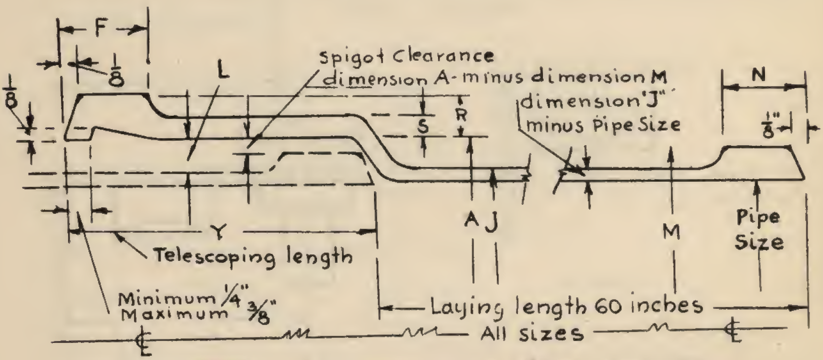
Fig. 18

MATERIAL — QUALITY AND WEIGHT

3.4 APPROVED MATERIALS.

3.4.1 *Periodic review*—The administrative authority shall periodically, at least once every 2 years, review the approved list of specifications and standards for materials in table 3.5 and also "Plumbing Fixtures," to check the designations, numbers, etc., which are used for identification and, if there are later issues, shall submit them for their legal adoption.

NOTE: All standards and specifications for materials are subject to change, therefore they need to be reviewed and brought up-to-date periodically. It is particularly important to review those standards and specifications which show a year of approval. Often such standards become obsolete in later years.



SERVICE-WEIGHT & EXTRA-HEAVY CAST IRON SOIL PIPE																				
PIPE SIZE	WEIGHT		LENGTH		A		M		J		Y		S		L		R		N	
(Nominal inside Diameter)	EX. HVY		SERVICE																	
	S.H. – D.H. POUNDS		S.H. – D.H.		XH	SER	XH	SER	XH	SER	XH	SER	XH	SER	XH	SER	XH	SER	XH	SER
2	25	26	20	21	3 1/16	2 15/16	2 3/4	2 5/8	2 3/8	2 1/4	2 1/2	2 7/16	3/16	3/16	11/32	11/32	7/16	13/32	11/16	11/16
3	45	47	30	31	4 3/16	3 15/16	3 7/8	3 5/8	3 1/2	3 1/4	2 3/4	2 11/16	5/16	7/32	11/32	11/32	1/2	7/16	3/4	3/4
4	60	63	40	42	5 3/16	4 15/16	4 7/8	4 5/8	4 1/2	4 1/4	3	2 15/16	5/16	7/32	11/32	11/32	1/2	7/16	13/16	13/16
5	75	78	52	54	6 3/16	5 15/16	5 7/8	5 5/8	5 1/2	5 1/4	3	2 15/16	5/16	7/32	11/32	11/32	1/2	7/16	13/16	13/16
6	95	100	65	68	7 3/16	6 15/16	6 7/8	6 5/8	6 1/2	6 1/4	3	2 15/16	5/16	1/4	11/32	11/32	1/2	7/16	13/16	13/16
8	150	157	100	105	9 1/2	9 1/4	9	8 3/4	8 5/8	8 3/8	3 1/2	3 1/2	7/16	9/32	7/16	7/16	11/16	7/32	1 1/8	1 1/8
10	215	225	145	150	11 5/8	11 3/8	11 1/8	10 7/8	10 3/4	10 1/2	3 1/2	3 1/2	1/2	3/8	7/16	7/16	3/4	5/8	1 1/8	1 1/8

Fig. 19

For example, the Cast Iron Soil Pipe Institute, in 1951, established a new standard for service-weight pipe, prescribing that there be only two weights of pipe—extra-heavy and service-weight. This new standard rendered obsolete and possibly unavailable several weights that were previously available. Fig. 19 gives dimensions and weights of the new service-weight cast iron soil pipe.

Federal specifications and Commercial Standards based on the new weights are currently being drafted by various federal committees and by private commercial associations.

3.4.2 *Specific usage*—Each chapter of this code indicates specifically the type of material permitted for the various parts of the plumbing system. The standards for each of those materials are given in table 3.5.

NOTE: Fig. 20 shows Table 3.5 of the code, in which are

	BUILDING SEWER	BUILDING DRAIN	WATER SERVICE MAIN	SOIL STACK	DRAINAGE BRANCHES	VENT STACK	VENT BRANCHES	COLD WATER DISTRIBUTION	HOT WATER DISTRIBUTION	BUILDING TO SEPTIC TANK	BUILDING STORM SEWER	BUILDING STORM DRAIN	PARAGRAPH REFERENCE
CLAY SEWER PIPE	x									x	x	x	11.2.1-11.2.2-11.2.4-13.2.6
CONCRETE SEWER PIPE	x									x	x	x	11.2.1-11.2.4-13.2.6
BITUMINIZED SEWER PIPE	x									x	x	x	11.2.1-11.2.2-11.2.4-13.2.6
ASBESTOS CEMENT PIPE	x									x	x	x	11.2.1-11.2.4-13.2.6
CAST IRON SOIL PIPE	x	x		x	x	x	x			x	x	x	11.1.2-11.1.3-11.2.1-11.2.2-11.2.4-12.1.3 12.1.4-12.1.15-13.2.1-13.2.3-13.2.4-13.2.6
CAST IRON (THREADED) PIPE				x	x	x	x						11.1.2-11.1.3-13.2.1
CAST IRON WATER PIPE	x	x	x							x	x	x	10.10.1-11.2.1-11.2.2-11.2.4 13.2.3-13.2.4-13.2.6
CAST IRON SOIL FITTINGS	x	x		x	x	x	x			x	x	x	11.1.2-11.1.3-11.2.1-11.2.2-11.2.4-12.1.3 12.1.4-12.1.5-13.2.1-13.2.4-13.2.6-13.2.3
CAST IRON (SCREWED) FITTINGS						x	x						11.1.2-11.1.3-12.1.3-12.1.5
CAST IRON (DRAINAGE) FITTINGS				x	x								11.1.2-11.1.3-13.2.5
WROUGHT IRON PIPE GALVANIZED				x	x	x	x	x	x				10.10.1-11.1.2-11.1.3-12.1.3-13.2.1-13.2.4
STEEL PIPE				x	x	x	x	x	x				10.10.1-11.1.2-11.1.3-13.2.1-12.1.3-13.2.4
OPEN HEARTH IRON PIPE				x	x	x	x	x	x				10.10.1-11.1.2-11.1.3-12.1.3-13.2.1-13.2.4
MALLEABLE IRON FITTINGS						x	x	x	x				10.10.1-11.1.2-12.1.5-12.1.3
MALLEABLE DRAINAGE FITTINGS				x	x								11.1.2-11.1.3-12.1.5-13.2.4
COPPER WATER TUBE			K	K	L	M		K	L				10.10.1-11.1.2-11.1.3- 12.1.3-13.2.1
BRASS PIPE I.P.S.			x					x	x				10.10.1-11.1.2-12.1.3-13.2.1
COPPER PIPE I.P.S.			x	x	x	x	x	x	x				10.10.1-11.1.2-11.1.3-12.1.3-13.2.1
SOLDERED JOINT FITTINGS				x	x	x	x	x	x				10.10.1-11.1.2-11.1.3-12.1.3-12.1.2-13.2.1
CAST BRASS SOLDERED FITTINGS				x	x	x	x	x	x				10.10.1-11.1.2-12.1.3-12.1.5-13.2.1
CAST BRASS FLARED TYPE FITTINGS			x					x	x				10.10.1
LEAD PIPE			x		x		x	x	x				10.10.1-11.1.2-11.1.3-12.1.3-12.1.5-13.2.1
STEEL PIPE CEMENT LINED			x					x	x				10.10.1

Fig. 20

listed the materials most often used in a plumbing system. The various chapters of the code give the choices of materials permitted for a given system, but local conditions must govern the final choice. Conditions to be considered are water and soil characteristics, traffic over piping, type of building and location, and presence of corrosive or acid wastes.

The recommendations in the National Plumbing Code provide a basis for safety and health protection. The recommendations do not limit the plumbing contractor or the engineer from recommending materials of longer life, or better construction, where his experience and judgment dictate such choice.

JOINTS AND CONNECTIONS

4.2 TYPES OF JOINTS.

4.2.1 *Calked joints*—Calked joints for cast iron bell-and-spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch deep and extending not more than ⅛-inch below rim or hub. No paint, varnish, or other coatings shall be permitted on the jointing material until after the joint has been tested and approved.

NOTE: Calked joints for cast iron soil pipe need no clarification. They are almost as old as the industry. The only new development in relation to cast iron is the establishment of the new weight standards illustrated in Fig. 19.

4.2.6 *Hot-poured joints*—Hot-poured compound for clay or concrete sewer pipe shall not be water-absorbent and when poured against a dry surface shall have a bond of not less than 100 pounds per square inch. All surfaces of the joint shall be cleaned and dried before pouring. If wet surfaces are unavoidable, a suitable primer shall be applied. Compound shall not soften sufficiently to destroy the effectiveness of the joint when subjected to a temperature of 160 degrees F., nor be soluble in any of the waste carried by the drainage system. Approximately 25% of the joint space at the base of the socket shall be filled with jute or hemp. A pouring collar, rope, or other device shall be used to hold the hot compound during pouring. Each joint shall be poured in one operation until the joint is filled. Joints shall not be tested until one hour after pouring.

4.2.7 *Precast joints*—Precast collars shall be formed in both the spigot and bell of the pipe in advance of use. Collar surfaces shall be conical with side slopes of 3 degrees with the axis of the pipe and the length shall be equal to the depth of the socket. Prior to making joint contact, surfaces shall be cleaned and coated with solvents and adhesives as recommended in the standard. When the spigot end is inserted in the collar, it shall bind before contacting the base of the socket. Material shall be inert and resistant to both acids and alkalies.

NOTE: Fig. 21 illustrates vitrified clay pipe joints and jointing compounds. They are leakproof, root resistant and flexible. The pipe is produced in 3-foot and 4-foot lengths, and the barrel is extra-strength pipe. Included are:

(a) Ground joint. (b) Molded joint. (c) Hard spigot slip-seal joint. (d) Push-lok joint. (e) Ceramicweld mechanical compression joint. (f) Screw-seal joint.

(a) GROUND JOINT. This consists of a rectangular sectioned rubber gasket which is compressed between accurately formed cylindrical surfaces on bell and spigot respectively.

Just prior to assembly the gasket is fitted over the ground cylindrical end of the spigot. A lubricant (rubber cement) is applied to the outside of the gasket and the inside of the bell. A clamp forces the two ends together.

Fig. 21 a- Ground joint. (Davids pantent)

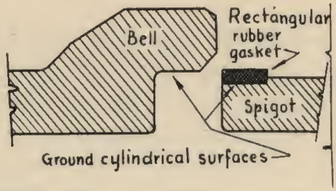


Fig. 21a

(b) MOLDED JOINT. The cylindrical surfaces on bell and spigot respectively are formed by the use of molded rigid-setting material. The gasket is compressed in the same manner as in the ground joint and is assembled in a similar way.

Fig 21 b. Molded Joint- (Davids pantent)

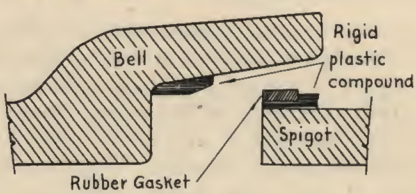


Fig. 21b

(c) HARD-SPIGOT SLIP-TYPE JOINT. The joint is tapered. The improvement consists in the use of a rigid tough plastic

Fig 21c- Hard-spigot slip-type joint

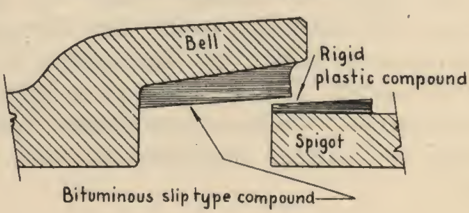


Fig. 21c

material on the spigot end of the pipe, and a bituminous slip-type compound on the interior of the bell. This provides for a ring of root-resistant material around the pipe joints.

(d) PUSH-LOK JOINT. This joint is different in the method used for making tight. It works in the same manner as the barb on a fishhook.

The design of the spigot end consists of two tapers. The first tapers up to a locking offset behind which the sealing taper starts. As the spigot end is pushed into the socket, the rubber-like offset undergoes a state of high compression. Once the offset has proceeded beyond the socket ring, it expands to its original diameter, forming a locking shoulder.

The polyvinyl chloride plastisol rings of the spigot and socket are molded and heat fused to the pipe in such manner that they are an integral part of it. This makes the joint chemical- and root-resistant.

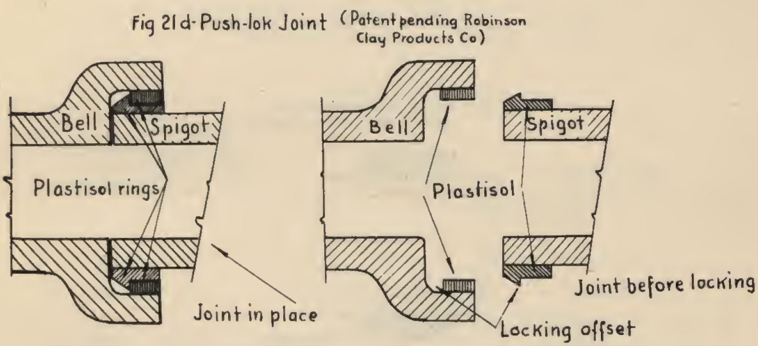


Fig. 21d

(e) CERAMICWELD MECHANICAL COMPRESSION JOINT. This joint has been used on the west coast for several years. It is different from the conventional type and so is the pipe. The pipe is made in 5-foot lengths and does not use bell or socket. Both ends are spigot ends. The pipe is jointed by means of a mechanical coupling.

(f) SCREW-SEAL JOINT. This joint is a new departure. It is a combination of modern plastic and vitrified clay to form a screwed leak-proof, flexible joint. Extra-strength clay pipe is manufactured with a male-threaded polyvinyl

chloride plastisol casting at each end. A collar of phenolic plastic with matching female thread fits onto the male pipe thread and the length of the pipe is then put together as for threaded pipe systems.

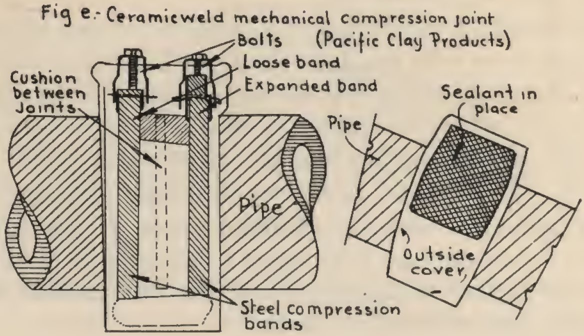


Fig. 21e

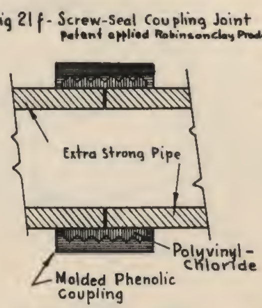


Fig. 21f

4.2.11 *Asbestos cement sewer pipe joints*—Joints in asbestos cement pipe shall be made with sleeve couplings of the same composition as the pipe, sealed with rubber rings. Joints between asbestos cement pipe and metal pipe shall be made by means of an adapter coupling calked as required in paragraph 4.2.1. [See Fig. 22.]

4.2.12 *Bituminized fiber pipe joints*—Joints in bituminized fiber pipe shall be made with tapered type couplings of the same material as the pipe. Joints between bituminized fiber pipe and metal pipe shall be made by means of an adapter coupling calked as required in paragraph 4.2.1. [See Fig. 23, also Bibliography.]

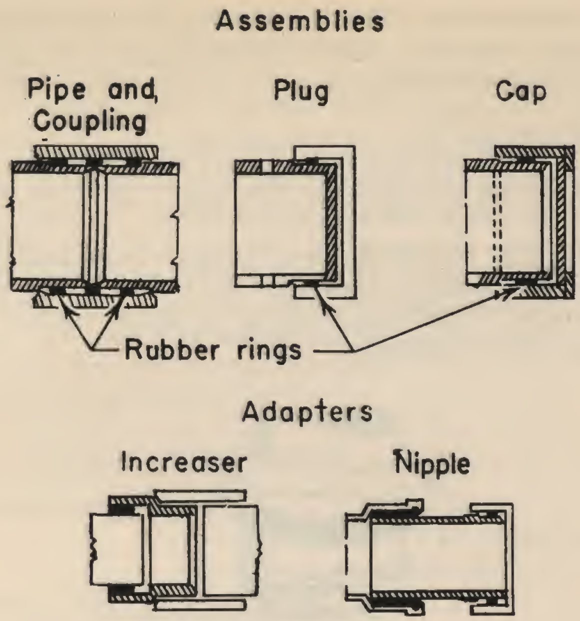


Fig. 22

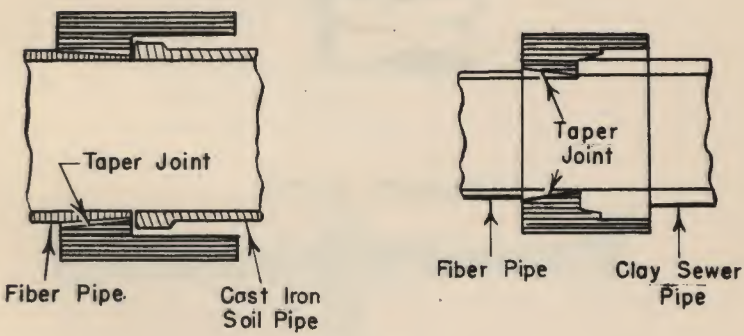


Fig. 23

NOTE: Bituminized fiber pipe is used for "house to street" sewer connections. The pipe and fittings have mating tapers which when properly swedged together form a watertight root-resistant connection. This pipe can be cut with an ordinary hand saw. The pipe and couplings are joined by placing a wood block against the last coupling and hitting it with a few blows of a hammer to drive the lengths together

inside the coupling. The same process is used for joining couplings. The pipe comes in 8-foot lengths and weighs 2.7 lbs. per foot of 4-inch pipe.

4.4 SPECIAL JOINTS.

4.4.5 *Ground joint brass connections*—Ground joint brass connections which allow adjustment of tubing but provide a rigid joint when made up shall not be considered as slip joints.

NOTE: Fig. 24 illustrates a metal-to-metal ground joint which is not considered a slip joint. Slip joints are permitted only on the house side of a fixture trap or within the trap seal of the trap.

Ground Joints

Fig. 24

TRAPS AND CLEANOUTS

5.1 TRAPS.

5.1.1 *Fixture traps*—Plumbing fixtures, excepting those having integral traps, shall be separately trapped by a water-seal trap placed as close to the fixture outlet as possible. [See Figs. 25 and 25a.]

(a) Provided, that a combination plumbing fixture may be installed on one trap, if one compartment is not more than 6 inches deeper than the other, and the waste outlets are not more than 30 inches apart.

(b) Provided, that one trap may be installed for a set of not more than 3 single-compartment sinks or laundry trays or three lavatories immediately adjacent to each other in the same room, if the waste outlets are not more than 30 inches apart and the trap is centrally located when three compartments are installed.

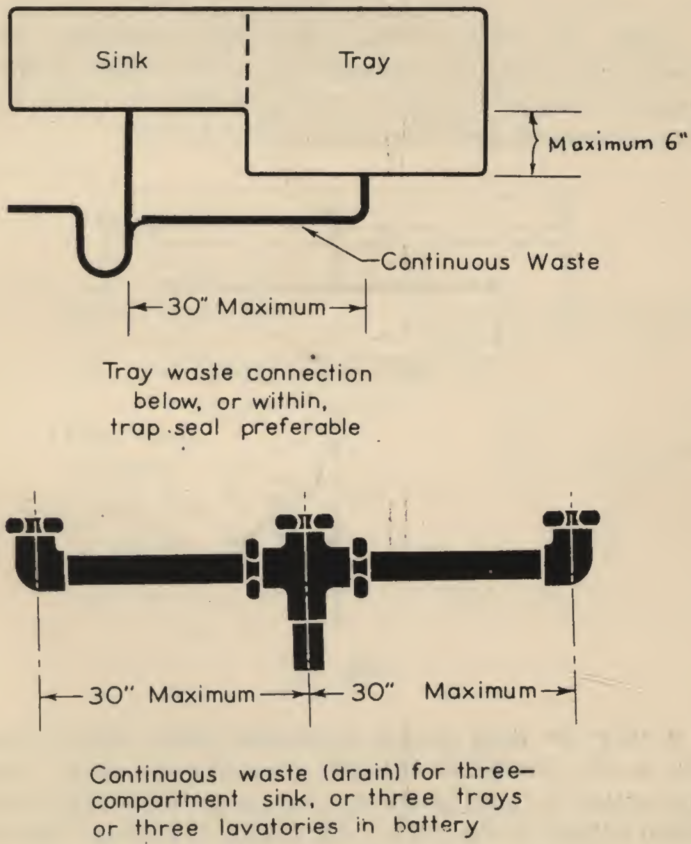
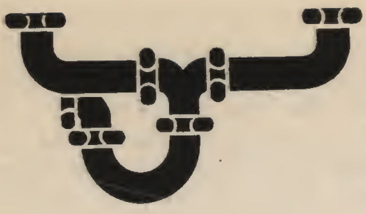
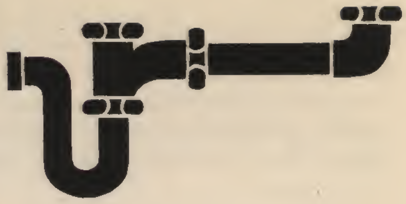


Fig. 25



Two-fixture continuous waste with center-trap outlet



Two-fixture continuous waste with end-trap outlet

Fig. 25a

NOTE: Fig. 26 illustrates three fixtures installed with a single trap under the center fixture. The outlets of the fixtures on each side must be installed within 30 inches of the trap, in accordance with paragraph 5.1.1(b).

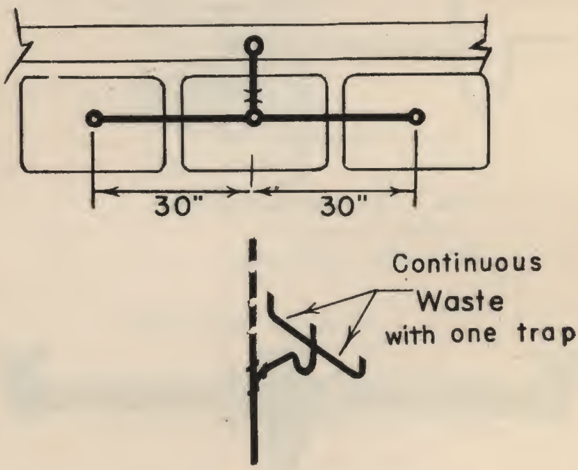


Fig. 26

A trap for each fixture eliminates odors which develop due to air circulation through a continuous waste. Odors are caused by food particles, lint, soap, and other wastes which adhere to the sides of the pipe and putrefy. Separate fixture traps also prevent backing up of waste into the lower compartment of a combination fixture when the compartments are of different depths, such as sink-and-tray.

5.1.2 *Distance of trap to fixture*—The vertical distance from the fixture outlet to the trap weir shall not exceed 24 inches. [See Fig. 27.]

NOTE: The maximum length of 24 inches is advisable only to meet special conditions. The shorter the distance from the fixture outlet to the trap, the better the trap will function. A long tailpiece causes greater velocity, and excess velocity siphons the trap seal. When the distance from fixture outlet to trap weir needs to be more than 12 inches, increase the size of the fixture drain one pipe size in order to reduce the velocity through the trap and prevent siphonage of the trap seal.

The same principle applies to the distance from an integral fixture trap, as in a water closet, to the connection with a horizontal drain. A water closet, of course, is designed and constructed so that flushing will siphon its contents. This action also siphons its trap seal, but the trap seal is restored by the refill provided in the flush tank or in the flushometer.

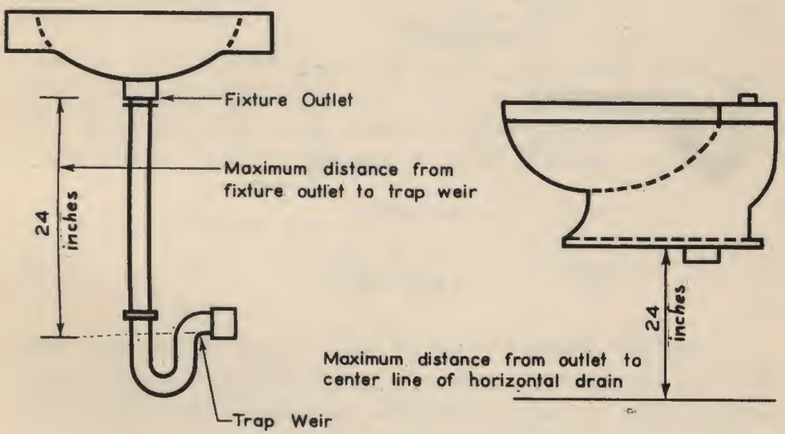


Fig. 27

5.2 TYPE AND SIZE OF TRAPS AND FIXTURE DRAINS.

5.2.3 *Type of traps*—

(a) Fixture traps shall be self-cleaning other than integral traps without partitions or movable parts, except as specifically approved in other sections of this code.

(b) Slip joints or couplings may be used on the trap inlet or within the trap seal of the trap if metal-to-metal ground joint is used.

(c) A trap integral with the fixture shall have a uniform interior and smooth waterway.

5.2.4 *Drum traps*—

(a) Drum traps shall be 3 or 4 inches in diameter and shall be provided with a water seal of not less than 2 inches.

(b) The trap screw shall be one size less than the trap diameter.

NOTE: The National Plumbing Code as well as most modern local plumbing codes recommend the use of P-traps and drum traps. (See Fig. 28.)

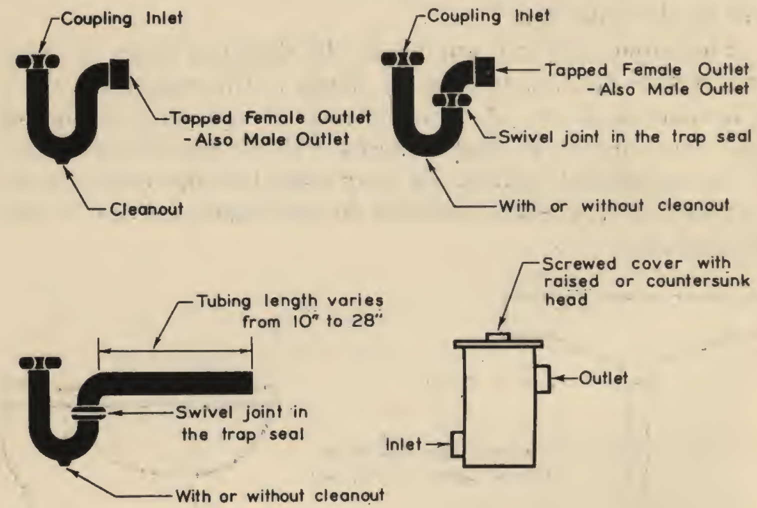


Fig. 28

A number of other types of trap are on the market, but they are not used as commonly as the standard traps, either because they are more expensive, or because they have some structural complications.

Properly designed anti-siphon traps resist back pressure and self-siphonage more effectively than the standard P-trap. But because they have interior partitions or movable parts, they are apt to clog sooner; or they become corroded and the partitions break down. As these accidents could happen without the knowledge of the owner, these traps are no assurance of safe operation.

The supposed advantage of the anti-siphon trap is that

its greater resistance to siphonage makes it possible to extend the drain line farther without venting than is advisable with a standard trap. Recent laboratory research has shown that correct design and correct balancing of the drainage system also make safe the installation of unvented drain lines, as recommended by the National Plumbing Code.

5.3.1 *Trap seal*—Each fixture trap shall have a water seal of not less than 2 inches and not more than 4 inches, except where a deeper seal is found necessary by the administrative authority for special conditions.

NOTE: The plumbing system should be designed so that positive or negative pressures greater than 1-inch are not developed within the fixture drain.

Fig. 29 illustrates what occurs when a trap is subjected to a negative pressure. .

(a) Shows the normal trap seal of the trap.

(b) A negative pressure siphons the trap seal.

(c) The pressure removed, the remaining trap seal returns to normal position less 1-inch which was siphoned.

When a 1-inch water seal remains in a 2″ trap seal, a positive or negative pressure meets the same resistance offered by a 2-inch water seal. The remaining 1-inch water seal provides the same relative safeguard in preventing sewer gas or vermin passage as does a 2-inch water seal.

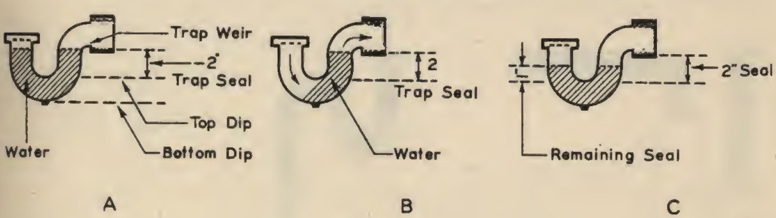


Fig. 29

Fig. 30 illustrates:

(a) The trap seal at normal level. When a positive pressure develops in the fixture drain, the seal is pushed upwards toward the fixture outlet, creating a 4-inch water column as at (b).

(b) When the pressure is removed suddenly, the column of water falls and some of the trap seal runs out through the drain as shown at (c).

(c) If the pressure developed in the fixture drain is no greater than 1-inch, the seal loss will seldom be more than 1-inch. When 1-inch seal remains in a trap, there is still sufficient water seal to protect the system against positive or negative pressure.

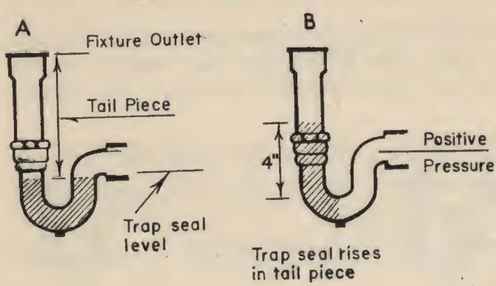


Fig. 30

5.3.6 *Prohibited traps*—

(a) No trap which depends for its seal upon the action of movable parts shall be used.

(b) Full S-traps are prohibited.

(c) Bell traps are prohibited.

(d) Crown-vented traps are prohibited.

5.3.7 *Double trapping*—No fixture shall be double trapped.

NOTE: Illustrated in Fig. 31 are prohibited traps. There

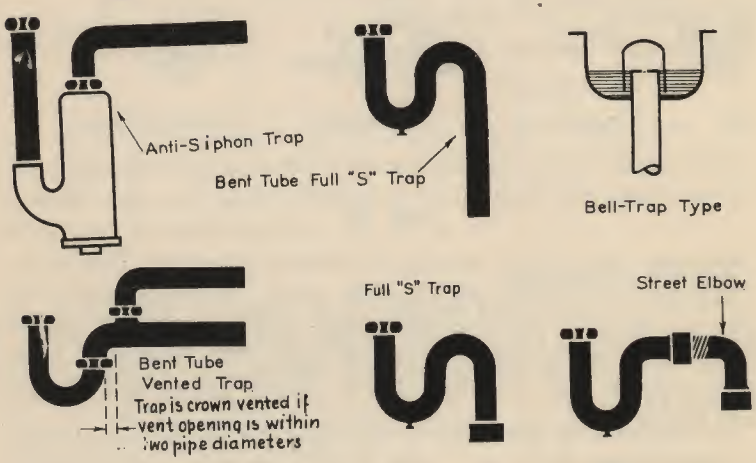


Fig. 31

are many variations of each of these prohibited types. Some full S-traps have a long drop tube. In fact, the usual P-trap can readily be converted into a full S-trap by installing an elbow at the outlet.

Crown-vented traps, as shown here, are prohibited by the National Plumbing Code. Crown venting includes distance up to two pipe diameters. In the case of a 1½-inch diameter trap, any distance up to 3 inches is considered crown-vented. (See paragraph 12.9.5.)

5.4 PIPE CLEANOUTS.

5.4.2 *Underground drainage*—Cleanouts, when installed on an underground drain, shall be extended to or above the finished grade level directly above the place where the cleanout is installed; or may be extended to the outside of the building when found necessary by the administrative authority.

NOTE: In an underground drain the cleanout must be brought up to grade or to the finished floor, as shown in Fig. 32. If a cleanout plug is located where there is traffic, the head should be countersunk to prevent accidents or breakage.

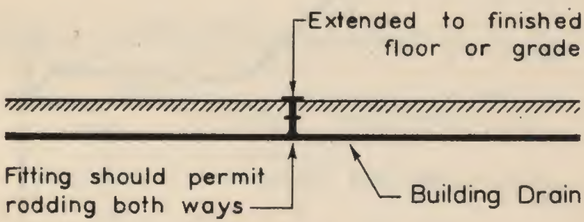


Fig. 32

Where it is impossible to extend the cleanout to grade or to the finished floor, the plumbing inspector may find it necessary to permit the extension of a dead-end pipe to the outside of the building wall with a cleanout brought up to grade. This practice is permitted in some communities where a public sewer is very shallow. In a one-story building, it is more desirable to rod through the vent terminal at the roof than to install a long dead-end branch for a cleanout. See Fig. 33.

5.4.3 *Change of direction*—Cleanouts shall be installed at each change of direction of the building drain greater than 45 degrees.

NOTE: When the change of direction is 45 degrees or less, it is not necessary to provide a cleanout. When the change in direction is more than 45 degrees—for example, 90 degrees—a cleanout should be required. It is also necessary to make the change by means of 45-degree wyes and ⅛ bends. See Fig. 34.

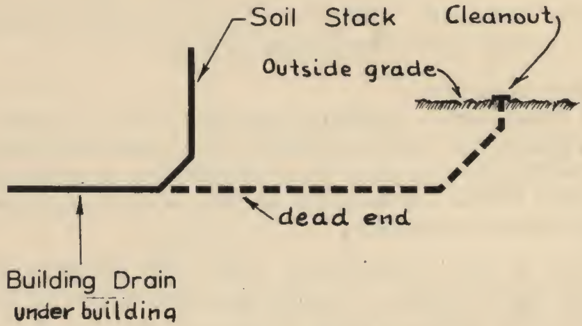


Fig. 33

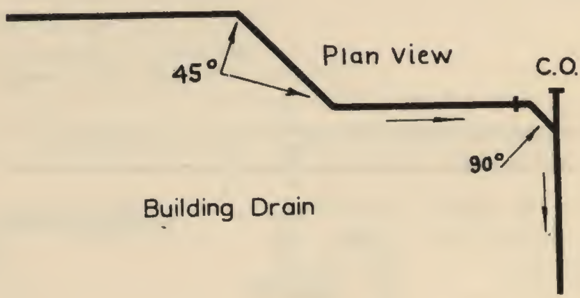


Fig. 34

5.4.4 *Concealed piping*—Cleanouts on concealed piping shall be extended through and terminate flush with the finished wall or floor; or pits or chases may be left in the wall or floor, provided they are of sufficient size to permit removal of the cleanout plug and proper rodding or cleaning of the system.

NOTE: If the cleanout cannot be extended, it can be made accessible by providing a plate as shown in Fig. 35. The plate (g) is held in place by a long screw (f). The cleanout plug may be drilled and tapped to receive the long screw by using a raised head plug (e). Where it is necessary to

conceal a cleanout plug, a covering plate or access door should be provided to permit ready access to the plug.

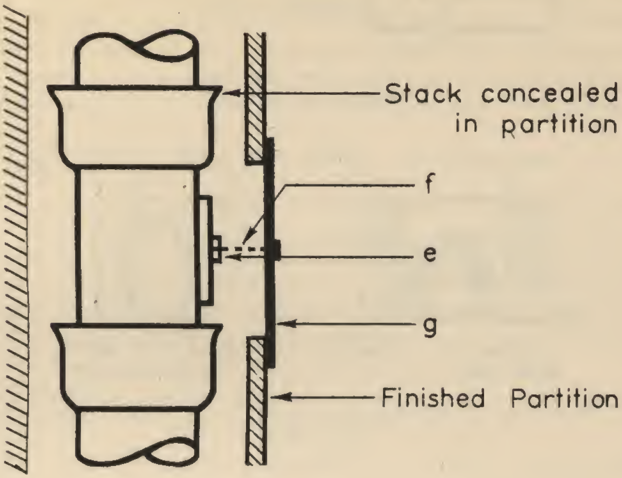


Fig. 35

Figs. 36 and 36a illustrate other locations of cleanouts.

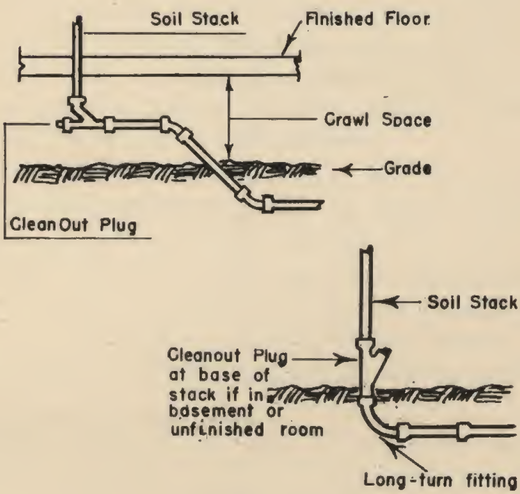
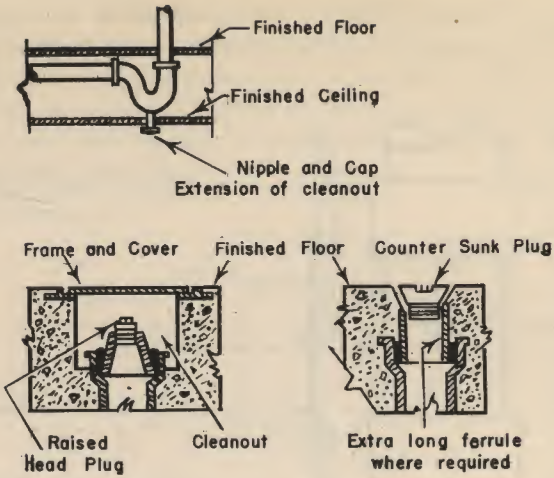


Fig. 36



Finished Floor
Finished Ceiling
Nipple and Cap
Extension of cleanout
Frame and Cover
Finished Floor
Counter Sunk Plug
Raised
Head Plug
Cleanout
Extra long ferrule
where required

Fig. 36a

INTERCEPTORS, SEPARATORS AND BACKWATER VALVES

6.1 INTERCEPTORS AND SEPARATORS.

6.1.1 *When required*—Interceptors (including grease, oil, and sand interceptors, etc.) shall be provided when, in the judgment of the administrative authority, they are necessary for the proper handling of liquid wastes containing grease, flammable wastes, sand, and other ingredients harmful to the building drainage system, the public sewer or sewage-treatment plant or processes.

6.2 GREASE INTERCEPTORS.

6.2.1 *Commercial buildings*—A grease interceptor shall be installed in the waste line leading from sinks, drains, or other fixtures in the following establishments when, in the judgment of the administrative authority, a hazard exists: restaurants, hotel kitchens or bars, factory cafeterias or restaurants, clubs, or other establishments where grease can be introduced into the drainage system in quantities that can affect line stoppage or hinder sewage disposal.

6.2.2 *Residential units*—A grease interceptor is not required for individual dwelling units or any private living quarters.

NOTE: The primary purpose of a grease interceptor is to assure free flowing drainage through pipe lines at all times by intercepting, separating, accumulating and recovering grease from the waste water lines. The most positive and simplest means of doing this in a grease interceptor is by employing the principle of flotation. The first essential in the operation of this principle is the elimination of excessive turbulence of incoming waste water. This is accomplished by correctly designed baffles which act to retard the flow after it enters the interceptor, thus allowing the grease to separate from the water and rise to the surface, where it may be skimmed and removed.

One of the generally accepted methods for sizing and for measuring flow rates and grease retention capacities for grease interceptors has been published by the Plumbing and Drainage Institute, based on data established by an independent testing laboratory. The flow rate through the interceptor is adjusted by a flow control device. Fig. 37 illustrates some of the interceptors commonly used.

6.14 BACKWATER VALVES.

6.14.1 *Fixtures subject to backflow*—The installation of backwater devices shall be in accordance with lawful requirements of the administrative authority having jurisdiction over the public sewer system.

6.14.2 *Fixture branches*—Backwater valves shall be installed in the branch of the building drain which receives only the discharge from fixtures located within such branch and below grade.

NOTE: Fig. 38 illustrates the installation of a backwater valve as per paragraph 6.14.2.

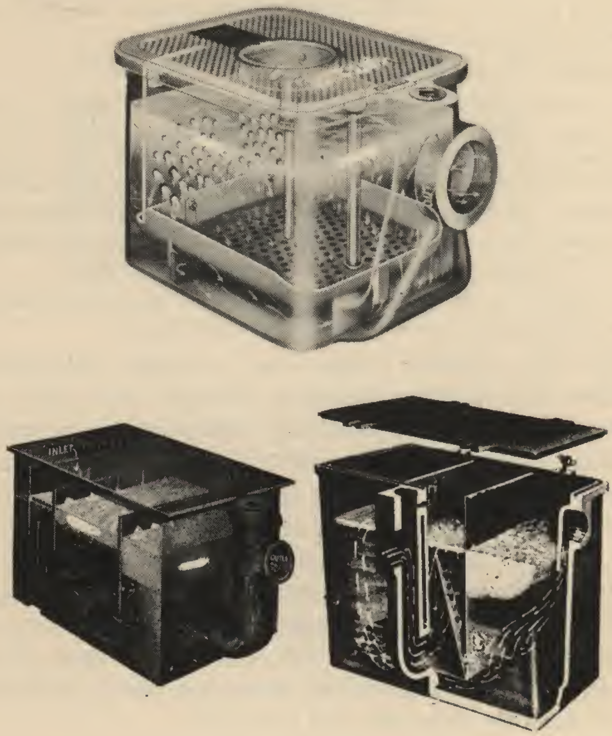


Fig. 37

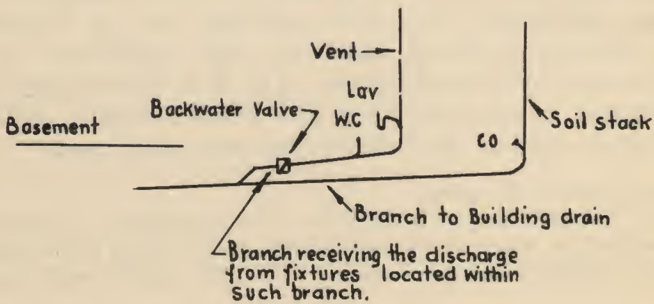


Fig. 38

7.3 OVERFLOWS.

7.3.1 *Design*—When any fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture cannot rise in the overflow when the stopper is closed, or remain in the overflow when the fixture is empty. [See Fig. 39.]

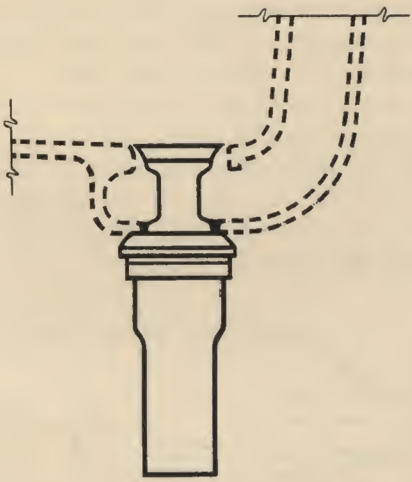


Fig. 39

NOTE: An overflow in a lavatory is a protection against self-siphonage of the trap seal. A current trend is toward lavatories without overflows. Eliminating the overflow eliminates the source of odors and lessens the cleaning chore. When lavatories without overflows are planned for installation, it is necessary to guard against siphonage of the trap seal by slowing down the discharge through the outlet. Loss of the trap seal permits sewer odors and vermin to enter the bathroom.

Flat bottom lavatories are less likely to induce trap siphonage than round bowl lavatories. Like a flat bottom sink or bathtub, a flat bottom lavatory, after draining, is left with a residue of water which drains slowly into the trap, restoring its water seal.

The following test for self-siphonage of lavatories may be used by anyone desirous of checking performance.

Install lavatory in the normal position with a 1¼-inch drain plug tailpiece and a P-trap connected to a 1¼-inch drain line. The drain should slope 1¼ inches per foot and connect into a sanitary tee. Install small sections of pipe at the top and bottom of the sanitary tee. The length of the drain from trap weir to vent should be in accordance with local requirements. (The National Plumbing Code permits a 2-foot 6-inch unvented drain pipe.) Fill the lavatory with water, then discharge by pulling stopper or pop-up opened full. Repeat test 10 times. Observe trap seal through a manometer or glass tube installed at the trap cleanout as shown in Fig. 39a. If any of the 10 tests shows a trap seal loss of more than one inch, the lavatory is considered as not meeting the test.

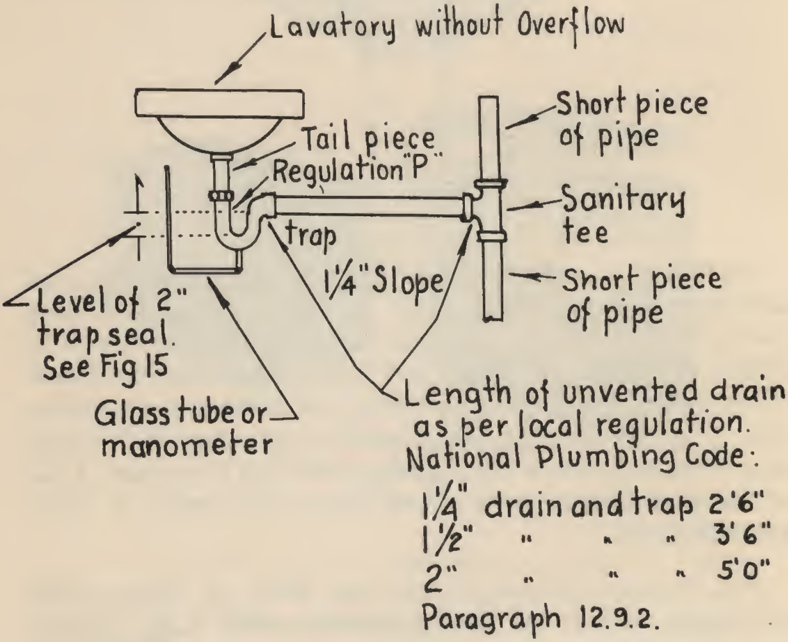


Fig. 39a

7.3.2 *Connection*—The overflow pipe from a fixture shall be connected on the house or inlet side of the fixture trap, except that overflows of flush tanks may discharge into the water closets or urinals served by them, but it shall be unlawful to connect such overflows with any other part of the drainage system.

7.7 WATER CLOSETS.

NOTE: A water closet, of course, is designed and constructed so that flushing will siphon out its contents. This action also siphons out its trap seal, but the trap is resealed by the refill provided in the flush tank or the flushometer. (See paragraph 5.1.2.)

7.10 LAVATORIES.

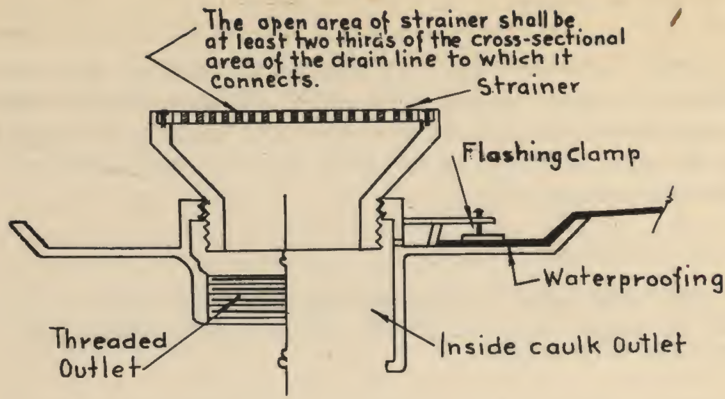
7.10.1 *Waste outlets*—Lavatories shall have waste outlets not less than 1¼ inches in diameter. Wastes may have open strainers or may be provided with stoppers.

NOTE: Table 11.4.2 indicates that the fixture-unit value of a lavatory is determined by the size of the waste outlet of the lavatory. Tests at the National Bureau of Standards indicate that a 1¼-inch lavatory plug produces a rate of discharge of 7½ gpm, whereas a 1⅜-inch plug increases the rate of discharge by 50%. The rate of discharge also is increased when a larger trap is used and when the overflow is eliminated.

7.11 SHOWER RECEPTORS AND COMPARTMENTS.

7.11.1 *Shower*—All shower compartments, except those built directly on the ground or those having metal enameled receptors, shall have a lead or copper shower pan, or the equivalent thereof, or as determined by the administrative authority. The pan shall turn up on all sides at least 2 inches above finished floor level. Traps shall be so constructed that the pan may be securely fastened to the trap at the seepage entrance making a watertight joint between the pan and trap. Shower receptacle waste outlets shall be not less than 2 inches and have removable strainer.

NOTE: Fig. 40 illustrates a prefabricated shower compartment which is included within the scope of paragraph 7.11.1. It should have a leakproof receptor and its finished surfaces and partitions should be impervious to water, soap, and body acids. The entire assembled shower compartment should be watertight, rigid, and easy to clean. The receptor should pitch sufficiently to drain completely yet minimize slipping. It should be made of materials such as precast stone, cement aggregates, preformed metal, or other materials of similar qualities.



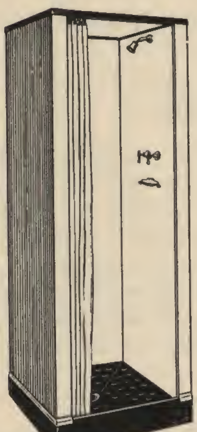

A prefabricated stall shower

Fig. 40

Fig. 41 illustrates a job-fabricated shower pan constructed of impervious long-lived materials, such as sheet lead and sheet copper.

NOTE: Shower stall floors should be completely lined with a 4-pound sheet lead pan and the lead turned up all around the walls at least 6 inches.

Fig. 41 illustrates how the corners of the pan should be folded tightly against the upstands and the tops soldered to prevent capillary action of water working itself onto the outside or into adjoining construction.

Where seams are necessary to joint large sheet lead pans, the sheets should be lapped at least ½-inch in the direction of flow to avoid pockets. The surface under the pan should be smooth to prevent drainage to lead pan. Coat lead on both sides with asphaltum compound. When wood floors are under a lead pan, nail heads should be set and a layer of 15 pounds-per-square-foot asphaltum impregnated building paper placed between wood and lead. A cement and clean sand mixture should be used inside pan as a foundation for tile floor.

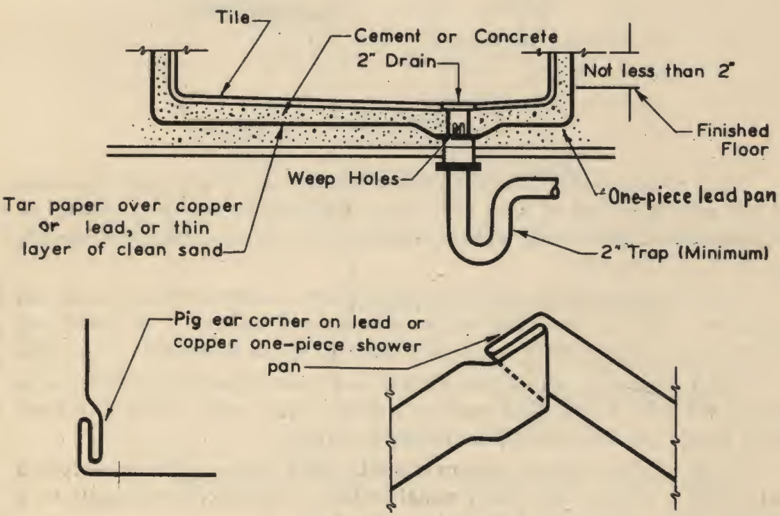


Fig. 41

Fig. 42 illustrates a prefabricated shower pan. It is made of several layers of 15-pound roofing paper or asphalt and

one center layer of asphalt-saturated burlap, thoroughly mopped together with hot asphaltum. It is turned up at the corners, making a pan 6 inches or more deep.

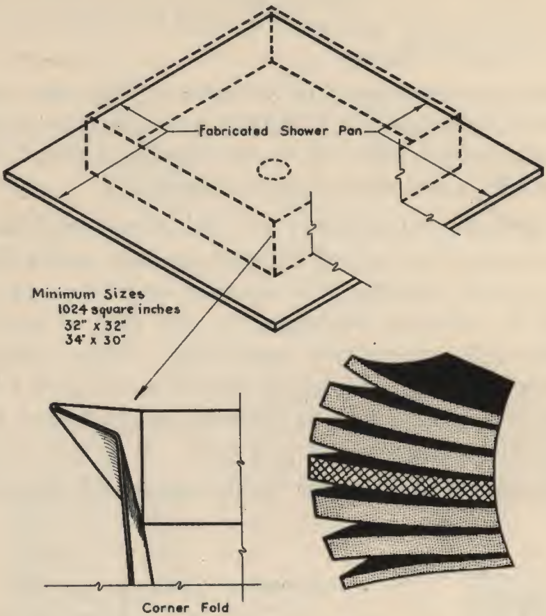


Fig. 42

7.11.3 *Dimensions*—Shower compartments shall have not less than 1,024 square inches of floor area and, whether rectangular, square, or triangular in plan, shall be not less than 30 inches in shortest dimension. [See Fig. 42.]

7.11.4 *Construction*—Floors under shower compartments shall be laid on a smooth and structurally sound base and shall be lined and made watertight with sheet lead, copper or other acceptable materials.

7.11.5 *Public or institution showers*—Floors of public shower rooms shall be drained in such a manner that no waste water from any head will pass over areas occupied by other bathers.

7.11.6 *Walls*—Shower compartments shall have walls constructed of smooth, noncorrosive and nonabsorbent waterproof materials to a height of not less than 6 feet above the floor.

7.11.7 *Joints*—Built-in tubs with overhead showers shall have waterproof joints between the tub and walls, and the walls shall be waterproof.

7.13 Food-waste-grinder units.

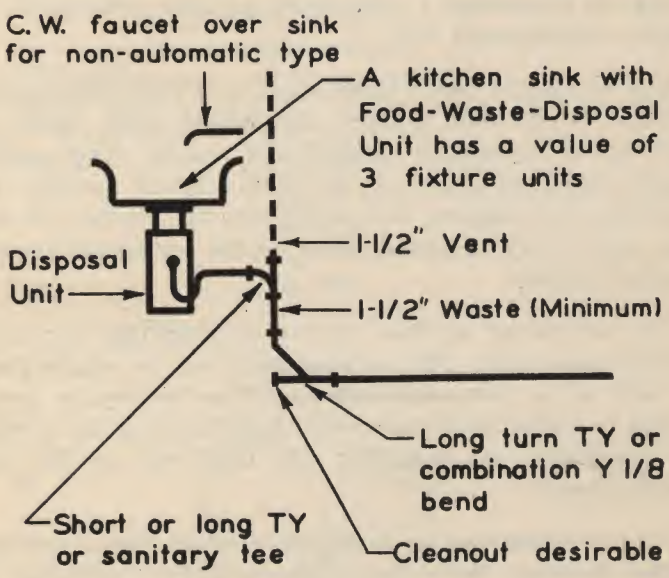
7.13.1 *Separate connections*—Domestic food - waste - disposal units shall be connected and trapped separately from any other fixture or compartment. Units may have either automatic or hand-operated water supply control.

7.12.2 *Food grinders*—Sinks on which a food-waste grinder is installed shall have a waste opening not less than 3½ inches in diameter.

NOTE: A food-waste grinder is now recognized as a plumbing-connected device. Sewage disposal authorities have found that the macerated ground-up food waste is easily dissolved or suspended in water and carried through the sewer to the treatment plant where it is readily attacked by bacterial action.

From the standpoint of design, there are two types:

(1) Continuous-feed type. The sink faucet (cold water) is turned on for flushing and the switch is turned on for grinding. If desired the unit may be kept open during grinding and flushing so that the scrapings from dishes can be dropped into it continuously.



Electric switch may be installed at wall, at front of cabinet, or other convenient location

Fig. 43

When food waste is disposed of, both switch and sink faucet should be turned off.

(2) Fixed capacity type, with water interlock. Food waste is deposited into the unit to the capacity of the unit. The waste plug, which also acts as a switch, is then put in and turned to an "on" position, and the sink faucet is turned for flushing. This acts upon the interlock and starts the grinding. The grinding stops when the water at the faucet is turned off, or when the waste plug is turned to an "off" position. This process is repeated until all food waste is disposed of.

In the hundreds of cities where food-waste grinding units are installed, they are considered a satisfactory, convenient means of disposing of household food waste. Studies are currently being made in various laboratories for the purpose of determining the most efficient method of installation, because, as is to be expected with a relatively new product, there are various schools of thought.

Fig. 43 illustrates a food-waste grinder installation in a single compartment sink.

Fig. 44 illustrates the installation of a food-waste grinder when it is placed in a two-compartment sink. Each compartment is separately trapped and vented. This arrangement is believed to provide the most efficient method of installation. A cleanout is desirable at the change of direction, and it may be placed either on the horizontal or on the vertical branch.

Fig. 45 shows another method of roughing for a two-compartment sink. This arrangement may be adapted to old as well as to new installations. The food-waste grinder should be installed in the lower roughing in order to reduce the possibility of siphoning the trap seal of the other compartment.

Fig. 46 illustrates an installation which has given satisfactory service. Both the grinder and the additional sink compartment are roughed with one trap to wall. The arrangement works satisfactorily when the fitting receiving the waste from sink and grinder is equipped with a dividing or flow-directing partition.

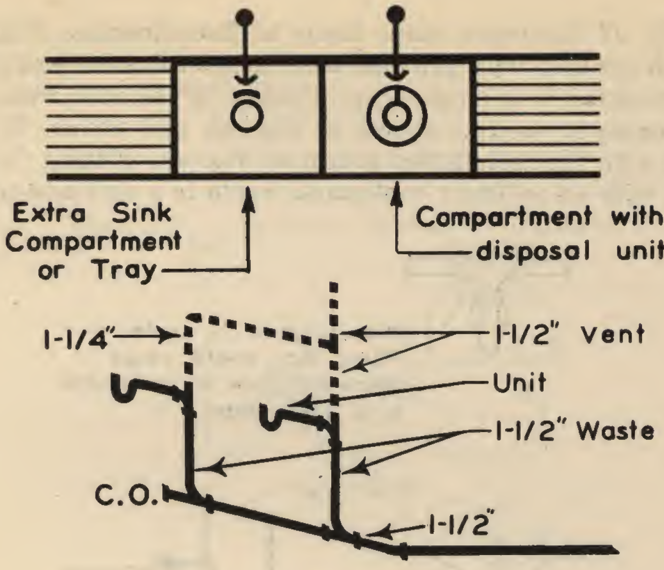


Fig. 44

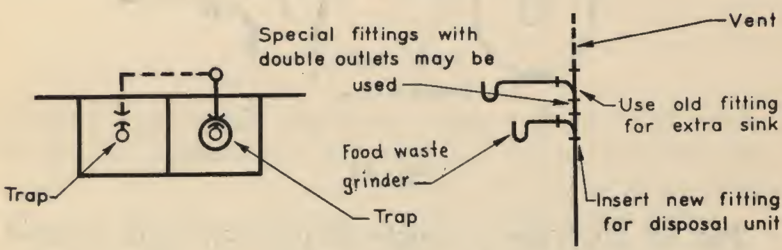


Fig. 45

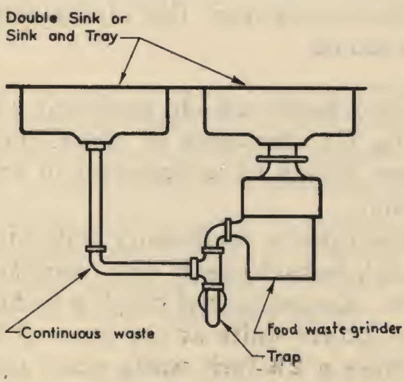


Fig. 46

Fig. 47 illustrates three kinds of flow-directing fittings which are used with grinders when a two-compartment sink is connected to a single trap. Fitting "a" is used with an arrangement such as shown in Fig. 48, and fitting "b" is used with the installation shown in Fig. 46. Fitting "c" is used with an ordinary continuous waste in a sink-and-tray.

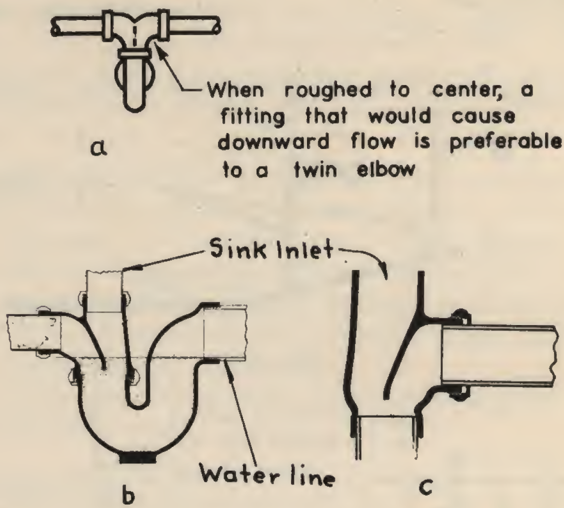


Fig. 47

Fig. 48 illustrates a double-compartment sink roughed with separate traps into a center double wye. This arrangement is not uncommon in alteration work as a means of avoiding costly reroughing. Old piping should be carefully rodded and cleaned.

In multi-story buildings—In multi-story buildings, waste lines receiving the discharge of sinks equipped with food waste grinders should be independent of any bathroom fixture connection.

Fig. 49 illustrates a multi-story building installation of two sinks back-to-back, each sink provided with a food-waste grinder. Assuming that this is a 6-story building with a total of 36 fixture units at the base of the stack, Table 11.5.3 prescribes a 2½-inch waste stack and a 2-inch vent stack. When two grinders are thus installed, use a long-turn

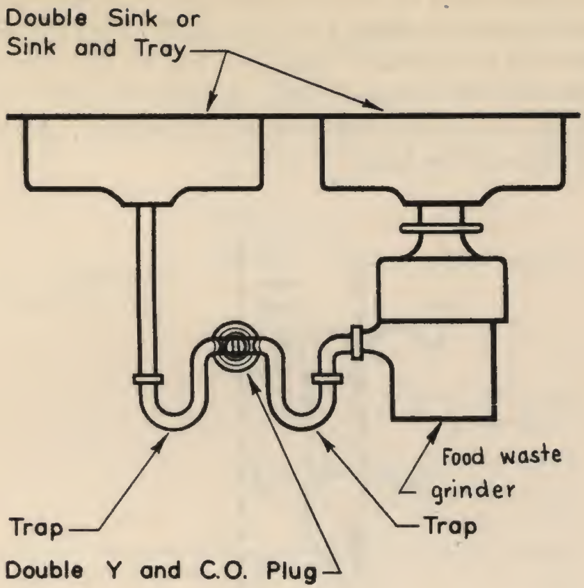


Fig. 48

TY or a combination wye fitting and a ⅛ bend. This minimizes the possibility of pumping the discharge from one grinder into the adjoining grinder. It also permits more effective rodding of the branch and vertical waste lines.

When a single grinder is installed, a sanitary tee is satisfactory. Connect the lowest-floor unit or sink into the base of the vent stack, so that the lowest unit will keep the vent line clear.

Installations of food grinders into existing roughing usually are more troublesome than new installations. Old piping must either be thoroughly cleaned or replaced. The piping *must* be in good, clean condition. Otherwise it will cause unnecessary stoppages, and additional expense.

Fig. 50 shows a grinder installed under a sink using a full S-trap. A unit so installed will cause noise and could siphon the trap. This is not a desirable installation.

Fig. 51 illustrates an installation which is not always satisfactory since ground waste food might be pumped into the

other compartment of the sink-and-tray. Should one compartment be covered, there is the possibility that the pumped-in waste will accumulate unnoticed until odors develop or until the cover is removed. This condition is apt to happen where there is a sink-and-tray combination and a drainboard is installed over the tray.

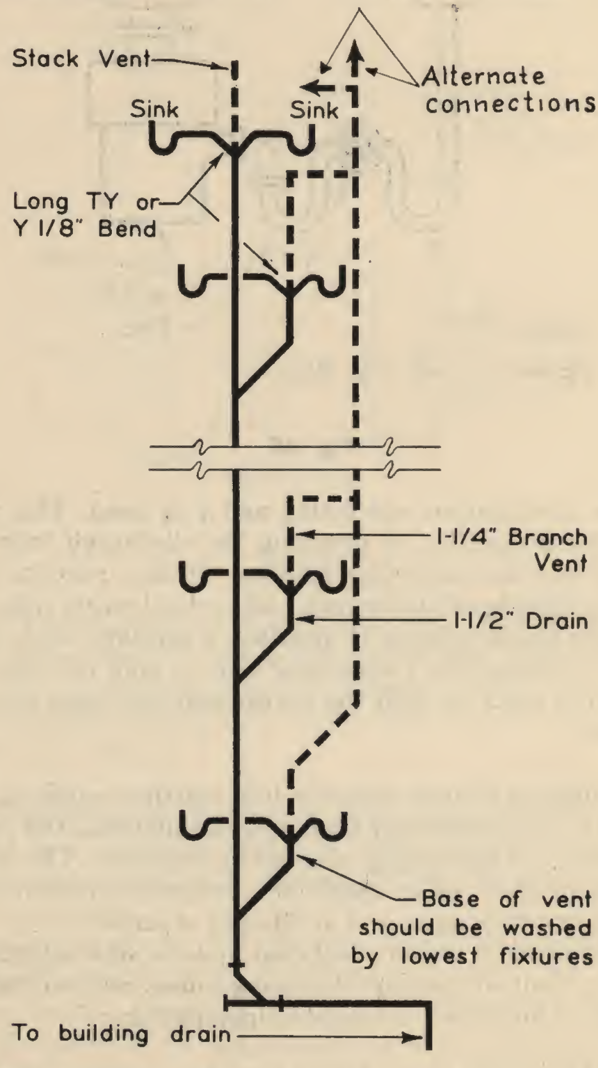
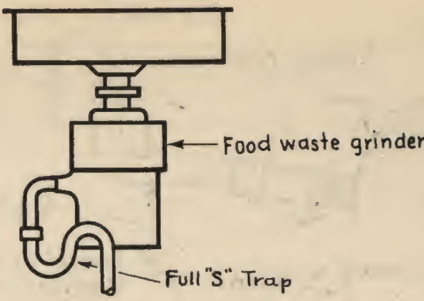


Fig. 49



View from rear

Fig. 50

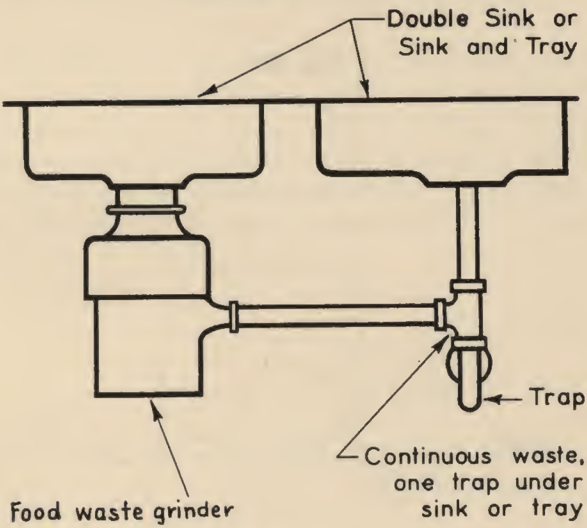


Fig. 51

Fig. 52 illustrates a recent development: Where a dishwashing machine is installed adjoining a food waste grinder, it is possible to utilize the grinder unit for the discharge waste of the dishwasher. The food waste grinder is equipped with what might be called a horn which receives the discharge from the dishwashing machine. Washing machine discharges should be made through an air gap or any other means that will prevent backflow.

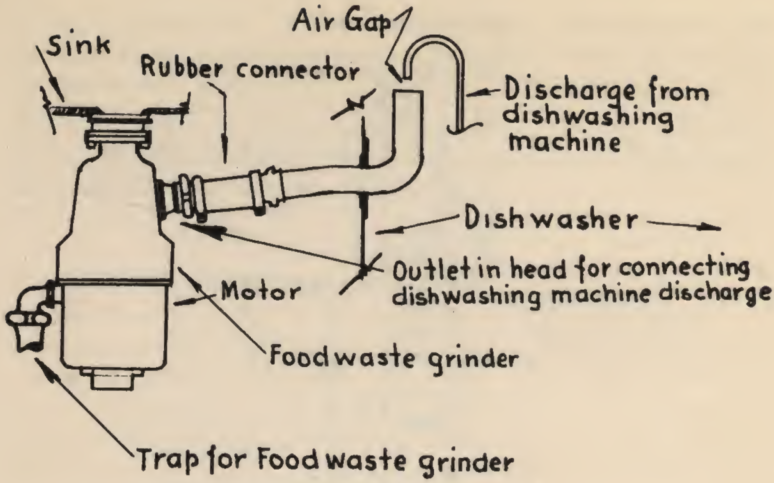

Air Gap
Sink
Rubber connector
Discharge from dishwashing machine
Dishwasher
Outlet in head for connecting dishwashing machine discharge
Motor
Foodwaste grinder
Trap for Foodwaste grinder

Fig. 52

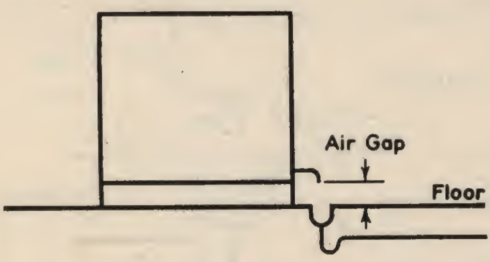
INDIRECT WASTE PIPING AND SPECIAL WASTES

9.1 INDIRECT WASTE PIPING.

9.1.2 *Food handling*—Establishments engaged in the storage, preparation, selling, processing, or otherwise handling of food shall have the waste piping from all refrigerators, ice boxes, rinse sinks, cooling or refrigerating coils, laundry washers, extractors, steam tables, egg boilers, coffee urns or similar equipment, discharge indirectly into a water-supplied sink or receptor, and the waste outlet shall terminate at least 2 inches above the flood rim of such sink or receptor. [See Figs. 53, 54 and 55.]

NOTE: An indirect waste, or an air gap on the waste of any device used for the purpose of handling or preparing food, is intended to prevent the possibility of waste backing up to where the food is placed and contaminating it. Hospital equipment such as sterilizers and laboratory sinks must be installed with a positive separation between the equipment outlet and the drainage inlet in order to prevent contamination.

Fig. 53 illustrates an air gap under a waste from an ice refrigerator. The melted ice is collected inside the box and then brought outside at one point for wasting. If the waste outlet were connected without an air gap, and if there should be a stoppage in the drainage system, sewage could easily back up into the ice box and contaminate food stored in it.



Box refrigerator for food storage may drip into a floor drain located beside box

Fig. 53

Fig. 54 shows a bar or soda fountain sink counter. An indirect waste from such equipment will prevent sewage backing up into the sink. An indirect waste would also eliminate the need for exposed vents.

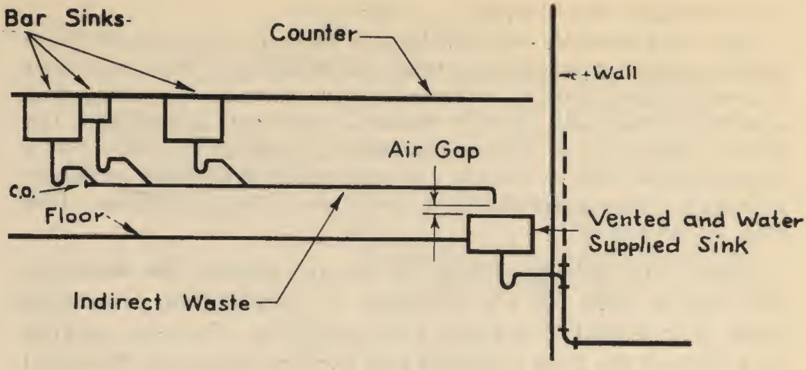


Fig. 54

Fig. 55 shows a potato peeler, one of the devices installed in a commercial kitchen. This peeler should be provided with an indirect waste connection. An indirect waste also is necessary for a bain-marie, vegetable washers and similar kitchen devices.

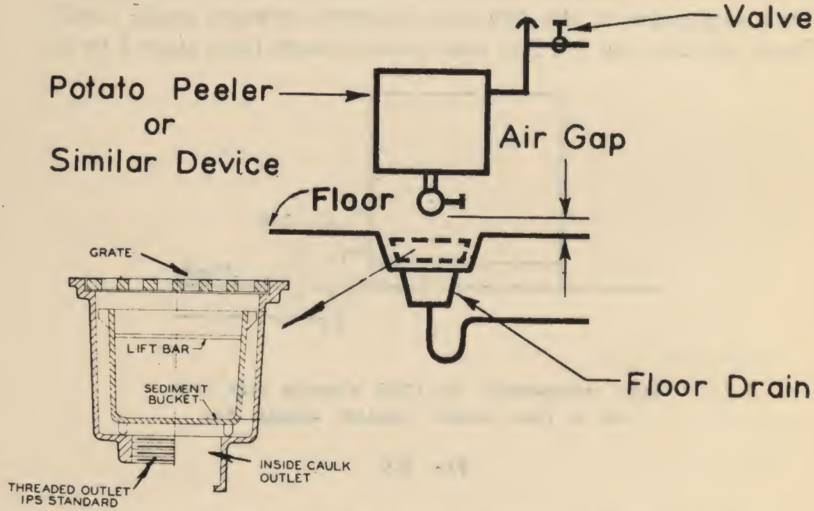


Fig. 55

Figs. 56 and 57 show two safe methods of connecting a commercial dishwashing machine. Fig. 56 shows the waste connected through an air gap. Fig. 57 shows the waste from

the dishwasher connected direct into the drainage system. A floor drain is connected to the horizontal waste to which the dishwasher waste connects. Should there be a sewage back-up in the line, it would overflow only onto the floor, but could not back up into the dishwashing machine which is at least 2 feet higher.

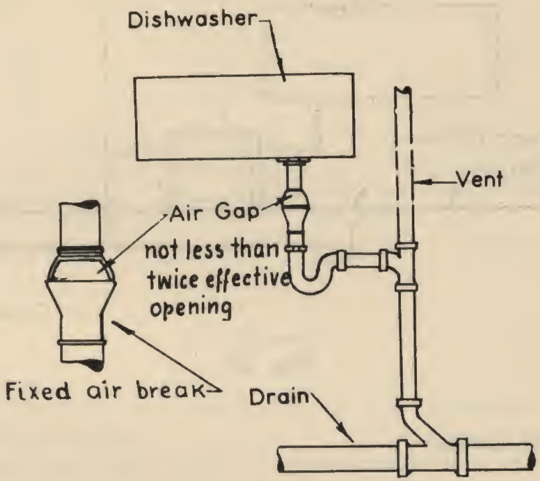


Fig. 56

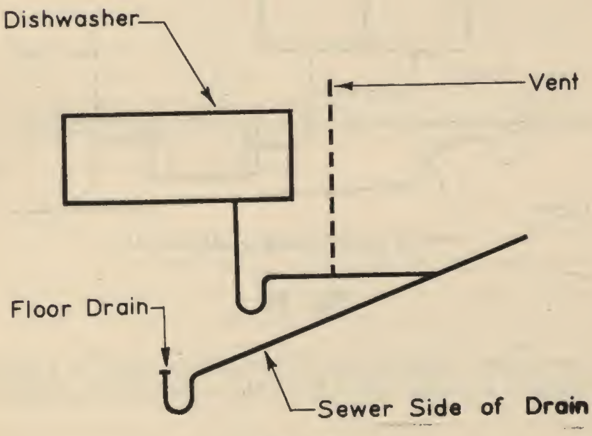


Fig. 57

9.1.4 *Interceptor*—An interceptor may be placed on the outlet side

of the dishwashing machine, or on the discharge side of the indirect waste receptor. [See Figs. 58 and 59.]

Figs. 58 and 59 show safe methods of connecting a **grease** trap for a dishwasher or pot sink.

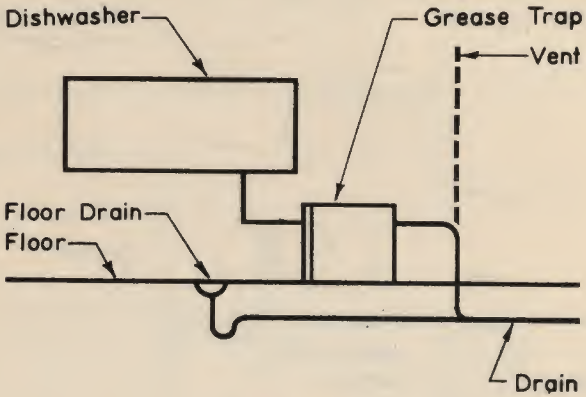


Fig. 58

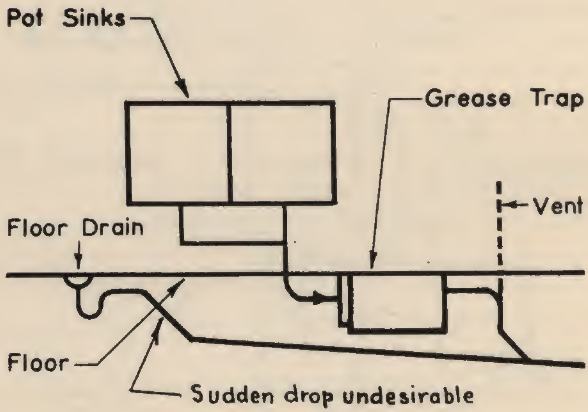


Fig. 59

9.1.5 *Connection*—Indirect waste connections shall be provided for drains, overflows or relief vents from the water-supply system. [See Fig. 60.]

Fig. 60 illustrates a relief pipe installed as an indirect connection over a floor drain. The overflow from a roof tank should spill close to a roof drain on the roof of the building.

The discharge from the overflow should terminate at least 6 inches above the roof level. The overflow from a suction tank may be emptied through an indirect waste connection or into a sump or into a pit.

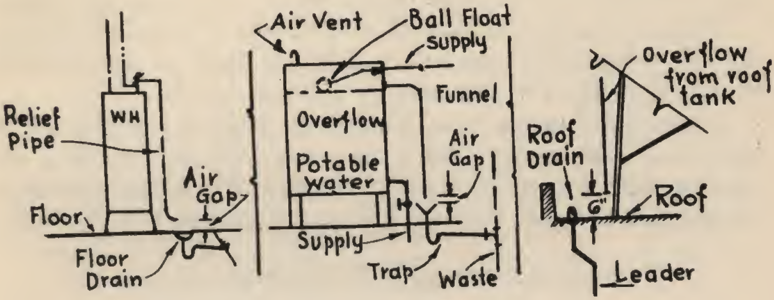


Fig. 60

9.3 LENGTH.

9.3.1 *Waste pipe*—Any indirect waste pipe exceeding 2 feet in length shall be trapped.

9.3.2 *Maximum length*—The maximum length of the indirect waste to vent shall not exceed 15 feet.

9.3.3 *Cleaning*—Indirect waste piping shall be so installed as to permit ready access for flushing and cleansing.

NOTE: Each compartment of a soda fountain or bar sink when more than 2 feet apart should be provided with a fixture trap. (See Fig. 54.)

The length of an indirect waste should not exceed 15 feet. Cleanouts at both ends of an indirect waste are for cleaning and rodding when necessary.

9.9 SPECIAL WASTES.

9.9.1 *Acid waste*—Acid and chemical indirect waste pipes shall be of materials unaffected by the discharge of such wastes.

9.9.2 *Neutralizing device*—In no case shall corrosive liquids, spent acids, or other harmful chemicals which might destroy or injure a drain, sewer, soil, or waste pipe, or which might create noxious or toxic fumes, discharge into the plumbing system without being thoroughly diluted or neutralized by passing through a properly constructed and acceptable dilution or neutralizing device. Such device shall be automatically provided with a sufficient intake of diluting water or neutralizing medium, so as to make its contents noninjurious before being discharged into the soil or sewage system.

NOTE: Fig. 61 shows an arrangement which connects the waste from several cup sinks in a laboratory into one continuous waste and then as an indirect waste into a funnel. (Paragraph 9.9.) Piping should be of a kind that will not be affected by acids and other corrosive liquid wastes. Duriron, lead, chemical clay, hard rubber and similar materials are considered within the requirements of paragraph 9.9.1.

When a separate system of acid wastes is installed whereby the wastes are run into a diluting tank as an indirect waste, then the air gap may be omitted.

Gooseneck faucets over laboratory sinks are equipped to receive a hose spray. Each faucet should be provided, as shown, with a vacuum breaker to prevent possible backflow of hazardous liquid through spray and hose left in the sink.

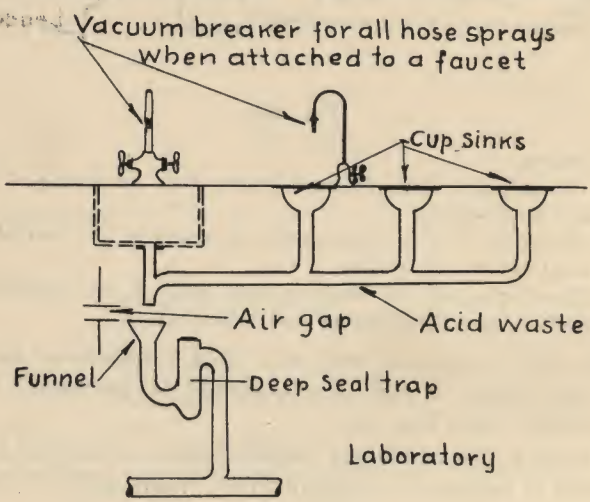


Fig. 61

Fig. 62 represents a laboratory room with sinks located at center of room and a dwarf partition between sinks. Generally, it is not desirable to run vent piping through the center of the room, yet the trap seal of the sinks must be protected against self-siphonage. This can be accomplished by the arrangement shown, which is permitted by the National Plumbing Code. See paragraph 12.22, Combination Waste-and-Vent System.

If floor drains are needed, they may connect direct into

the horizontal line, each individually trapped. Only one stack vent need be full size, in order to take care of the total connected load in the branch waste. See sink on right-hand side of drawing. Other sink vents may be the regulation size. The waste branch from an unvented sink must be 2 pipe sizes larger than the individual sink connection required.

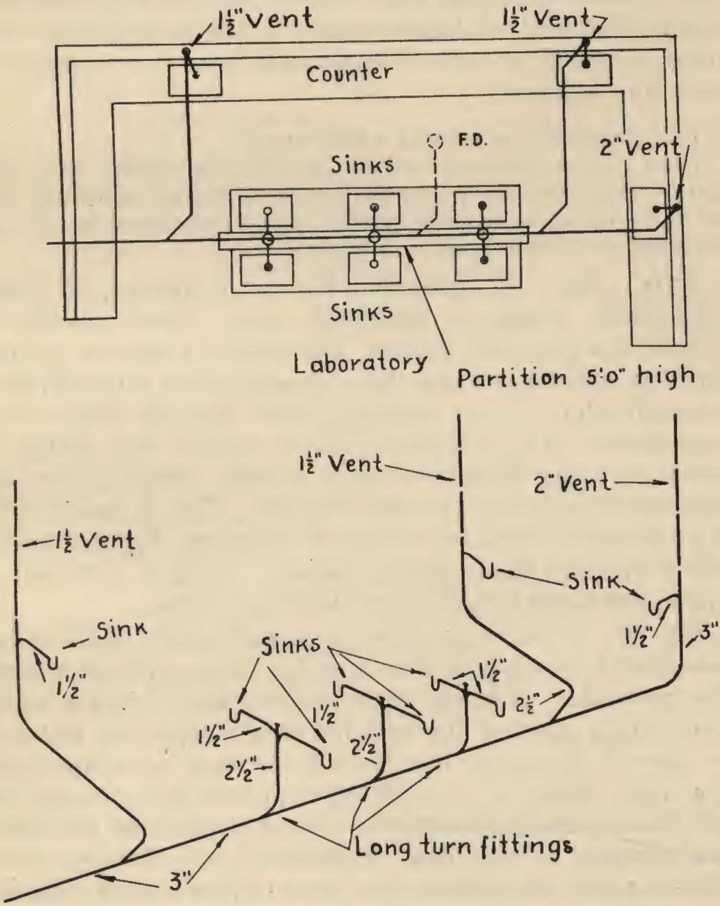


Fig. 62

10.2 COLOR CODE.

10.2.1 *Identification of piping*—All piping conveying non-potable water shall be adequately and durably identified by a distinctive yellow-coloring paint so that it will be readily distinguished from piping carrying potable water. (See ASA Z53.1—1945 Safety Color Code for Marking Physical Hazards.)

NOTE: A copy of the above ASA standard should be available for reference as to the standard color of paint to select for various piping systems. (See Bibliography and Symbols.) The ASA will have ready in the near future a revised standard of color recommendations for piping in a plumbing system.

10.4 PROTECTION OF POTABLE WATER SUPPLY.

10.4.1 *Cross-connections*—Potable water-supply piping, water discharge outlets, backflow-prevention devices or similar equipment shall not be so located as to make possible their submergence in any contaminated or polluted liquid or substance.

NOTE: Figs. 63 through 74 show examples of cross-connections found in buildings today which should be avoided in a plumbing system. Epidemics of typhoid, gastroenteritis, and other water-borne diseases have occurred from contamination of the potable water through such cross-connections. Any condition which permits any piping or device carrying potable water to become submerged in contaminated liquids is a potential hazard. This is equally true of a connection installed close to the surface of contaminated liquid whereby the negative pressure could be sufficient to siphon the liquid into the potable water system.

Fig. 63: A cold water riser in a multi-story building has connected to it on each floor a water closet without a backflow preventer. A break in the street main or in the water distributing main of the building would cause the water in the riser to flow back into the service main or street main. If a water closet in the building happened to be stopped up and its contents flooded to the rim of the fixture, the negative pressure in the riser, caused by water flowing down, would unseat the flushometer valve. This would create a vacuum in the tailpiece which connects on top of the water closet. The contents of the water closet would then rise in the tailpiece and flow down the cold water riser, contaminating the water in the street main. The extent to

which the potable water could become contaminated depends on the length of time that such condition is permitted to exist. It would be hard to say how many buildings in the area would be drawing contaminated water after the street main was returned to normal operation.

A vacuum breaker on the outlet of each flushometer connection would prevent such occurrence. A pressure-type backflow preventer at the point of entrance of the service main into the building would safeguard other buildings in the area.

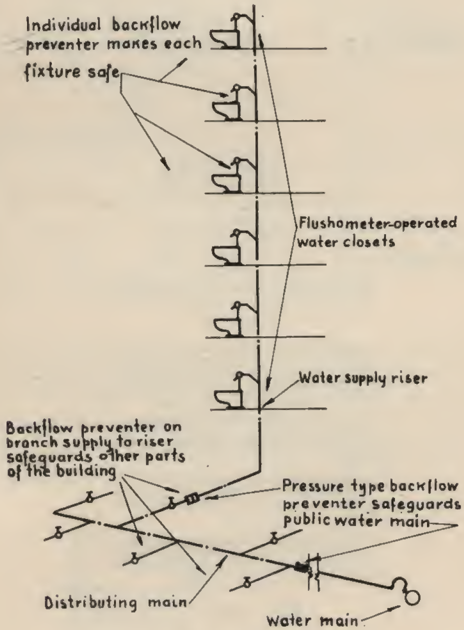


Fig. 63

Fig. 64 illustrates a typical reduced pressure backflow preventer valve and describes its operation. A reduced pressure backflow preventer may be installed in individual risers or in the main supplying an entire building, or in the main supplying several buildings, or wherever protection against backflow is required for a large area.

The small vacuum breaker or similar equipment which is installed in a tailpiece of a flush valve or the outlet of a valve protects the system from the particular fixture into

which the vacuum breaker is installed. The installation of a reduced pressure backflow preventer valve protects large areas or groups of fixtures.

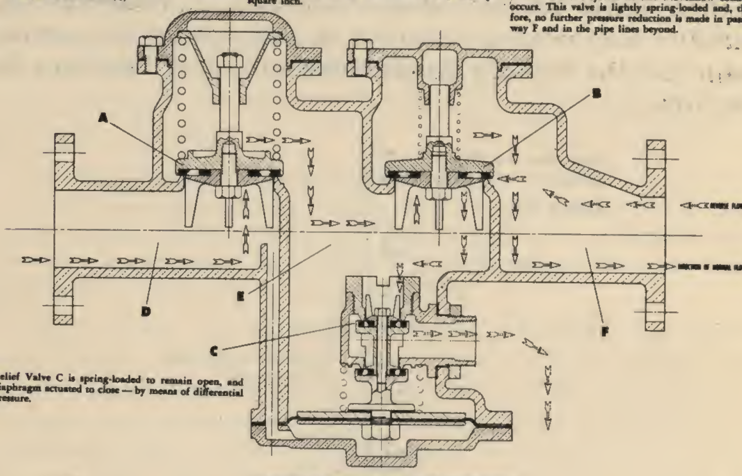


Fig. 64

Fig. 65 illustrates a water closet in which the trapway has been clogged, permitting the contents to rise in the bowl. A negative pressure taking place in the supply line or the shutting-off of the water riser in the basement could siphon the water closet contents into the supply line. A return to normal operation could cause the contaminated water to be drawn into a glass of drinking water at the kitchen sink or lavatory.

A vacuum breaker or backflow preventer installed at point "X" would eliminate the hazard.

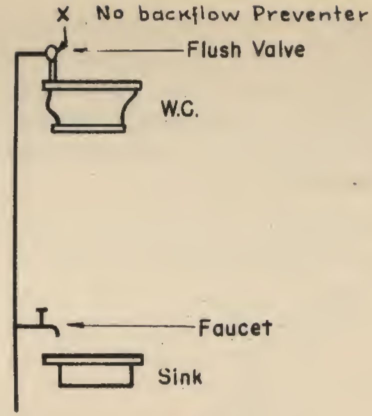


Fig. 65

Fig. 66. A water closet with an integral tank. Where the bottom of the tank is below the rim of the bowl and where the ball cock is not protected by a vacuum breaker, backflow can occur when there is a negative pressure in the water system. (See paragraph 7.7.4.)

7.7.4 *Close - coupled tanks*—The flush-valve seat in close - coupled water-closet combinations shall be 1 inch or more above the rim of the bowl, so that the flush valve will close even if the closet trapway is clogged, or any closets with flush valve seats below the rim of the bowl shall be so constructed that in case of trap stoppage, water will not flow continuously over the rim of the bowl.

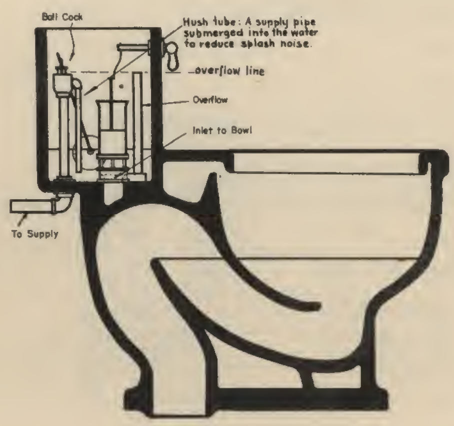


Fig. 66

NOTE: A stoppage in the water closet trap would cause the liquid in the bowl to rise to the flood rim, then flow back into the lower section of the tank. This contaminated water can readily be siphoned into the potable water system through the hush tube unless a vacuum breaker is provided above the water line of the tank ball cock.

Fig. 67. The contents of the lavatory with integral supply connections below the flood-level rim can be siphoned into the water supply system. Faucet outlet should be above the flood level of the lavatory, thus providing a 1-inch air gap.

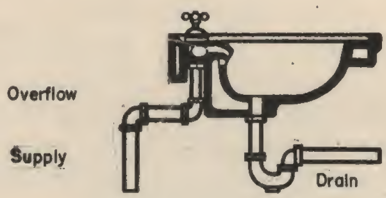


Fig. 67

Fig. 68. A bathtub with a faucet installed below the rim of the bathtub permits water from the tub to be siphoned into the water supply system. All supply faucets should be at least 2 inches above the rim of the tub.

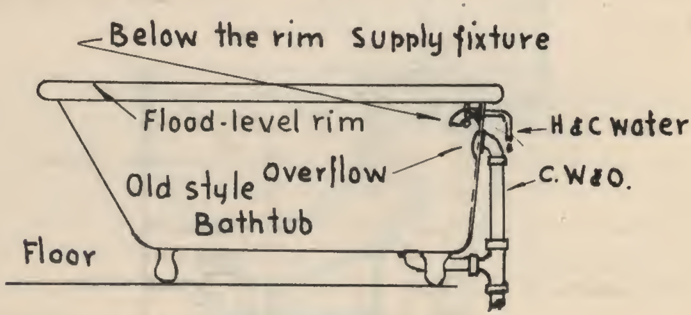


Fig. 68

Fig. 69. If the pressure in the fire line supply tank is greater than in the city main, and if the check valve flap is not tight, impure river water from the fire line can enter the drinking water supply system. A fire in the neighborhood could cause this condition and it could result in the contamination of a large area. The two water supplies should have no direct contact unless a pressure-type backflow control is installed between them.

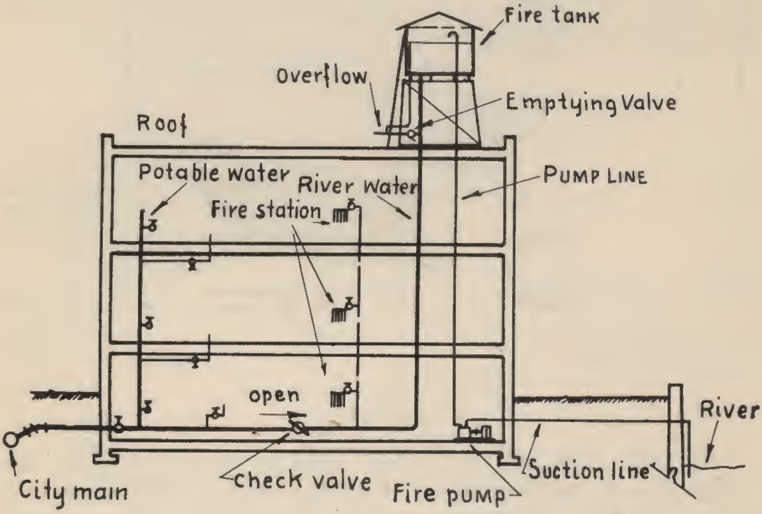


Fig. 69

Fig. 70. A break in the water-submerged condenser coil could cause a cross-connection. A pressure-type vacuum breaker, installed at "X," would be a safeguard against such a hazard.

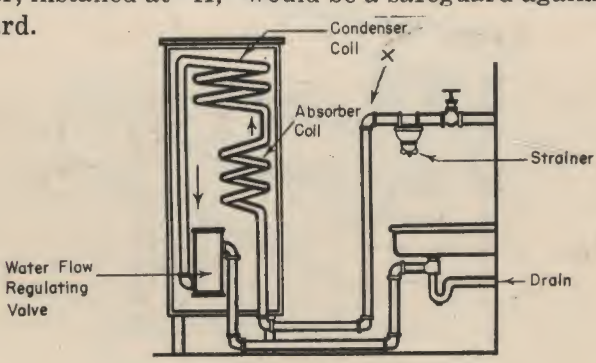


Fig. 70

Fig. 71. A cross-connection such as shown has actually occurred, causing an epidemic of goat-type undulant fever. Such a type of hose connection represents a direct cross-connetion. A vauum breaker or backflow preventer placed at point"X" would prevent back-siphonage.

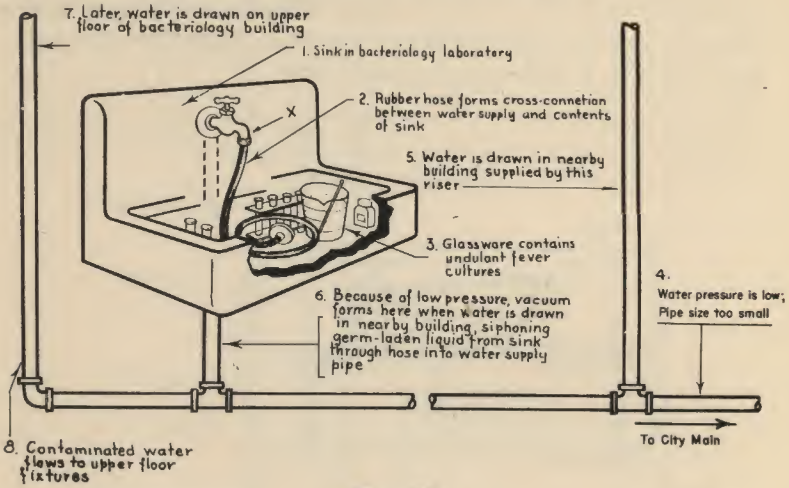


Fig. 71

Fig. 72. The supply fixture is a cross-connection. Any lowering of the pressure of the city main would permit unsafe water to enter the potable water supply through the combination faucet. It is safer to install separate faucets for hot and cold water.

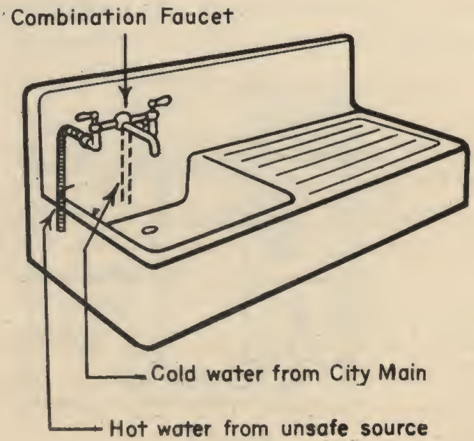


Fig. 72

Fig. 73 illustrates one of the various methods of providing make-up water for a system containing antifreeze solution. Antifreeze solution generally is poisonous and must not be permitted to enter the potable water system. To depend on valves is never a positive safeguard. Maintenance operators or owners might forget to shut off a valve, and check valves are never positive protection against back pressures. An air gap between the potable water system and the piping containing the antifreeze solution is the only safe method of protection. A direct cross-connection is dangerous and must be avoided.

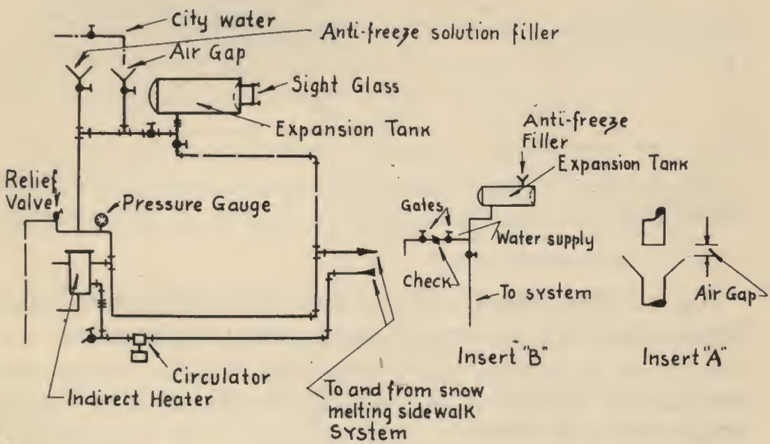


Fig. 73

Fig. 74. River water, supplemented by city water, was used for fire lines. A defective valve separated the waters. The pump on the fire line created a higher pressure in the fire line than existed in the city water line. This condition existed for two weeks, causing the city water to become polluted over a large area.

The installation of a pressure-type backflow valve will safeguard the potable water system against the river water being accidentally pumped into the potable city water supply system.

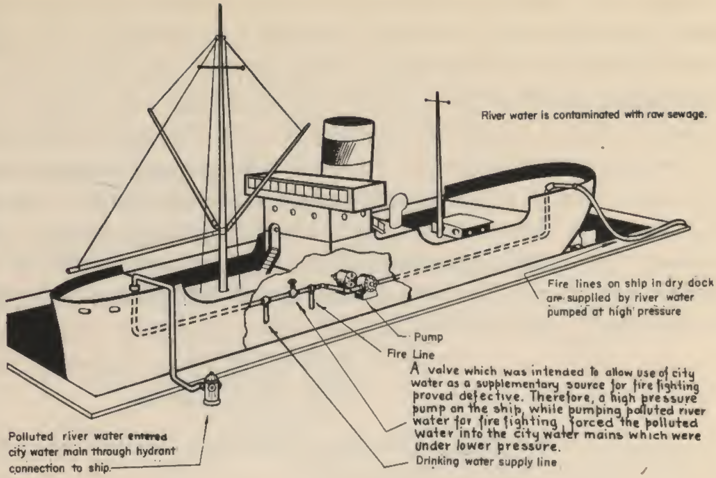


Fig. 74

For further study of safeguards against backflow or back-siphonage, see available literature listed in Bibliography.

10.6 WATER-SERVICE PIPE.

NOTE: Water-service pipe must be installed at least 12 inches above the top level of the building sewer pipe.

10.6.1 Except as permitted in paragraph 10.6.2, the underground water-service pipe and the building drain, or building sewer, shall be not less than 10 feet apart horizontally and shall be separated by undisturbed or compacted earth.

10.6.2 The water-service pipe may be placed in the same trench with the building drain and building sewer, provided the following conditions are met:

The bottom of the water-service pipe, at all points, shall be at least 12 inches above the top of the sewer line at its highest point.

The water-service pipe shall be placed on a solid shelf excavated at one side of the common trench.

The number of joints in the service pipe shall be kept to a minimum.

The materials and joints of sewer and water-service pipe shall be installed in such manner and shall possess the necessary strength and durability to prevent the escape of solids, liquids, and gases therefrom under any known adverse condition such as corrosion, strain due to temperature changes, settlement, vibrations and superimposed loads.

10.6.3 *Stop-and-waste valve combination* — Combination stop-and-waste valves and cocks shall be installed in an underground service pipe.

NOTE: In selecting the kind of pipe to be used for the service main, the water characteristics or mineral contents of the water as well as ground conditions should be given careful study. The kind of piping that has been used for many years locally and which is known to be satisfactory is a safe choice. The degree of exterior corrosion will vary with the ground composition, such as whether it is filled-in or solid undisturbed ground, or rock. If filled-in ground, it is well to provide new clean earth at bottom, sides and top of pipe to slow down the corrosive action which generally takes place in filled-in ground. Ground which has been filled with cinders, waste food, peelings, and the like, is probably the least desirable into which to install any piping.

Piping installed in one piece from main to house will safeguard the water supply it carries, even if installed in the same trench with the sewer. (See paragraph 11.2.)

Before the service main trench is backfilled, the main should be tested by keeping up the full pressure available in the main at least 30 minutes without showing any leaks.

10.10 WATER-DISTRIBUTION PIPE, TUBING AND FITTINGS.

10.10.1 Materials for water-distribution pipes and tubing shall be brass, copper, lead, cast iron, wrought iron, open-hearth iron, or steel, with appropriate approved fittings. All threaded ferrous pipe and fittings shall be galvanized (zinc-coated) or cement lined. When used underground in corrosive soil, all ferrous pipe and fittings shall be coal-tar enamel-coated, and the threaded joints shall be coated and wrapped after installation.

10.11 ALLOWANCE FOR CHARACTER OF WATER.

10.11.1 *Selection of material*—When selecting the material and size for water-supply pipe, tubing or fittings, due consideration shall be given to the action of the water on the interior and on the soil, fill or other material on the exterior of the pipe. No material that would produce toxic conditions in a potable water system shall be used for piping, tubing or fittings.

NOTE: In sizing the water supply distributing system, determine the pipe size by the method given in Appendix D of the National Plumbing Code. Undersized piping tends to cause pipe noises and water hammer.

Information on local water characteristics can be obtained from the local water department, or from the U.S. Public Health Service.

10.11.2 *Used piping*—No piping material that has been used for other than a potable water supply system shall be reused in the potable-water-supply system.

10.12 Water-supply control.

10.12.1 *Water-supply control*—A main shut-off on the water-service pipe shall be provided near the curb and, also, an accessible shut-off valve with a drip valve shall be provided inside near the entrance of the water-service pipe into the building. [See Figs. 75 and 76.]

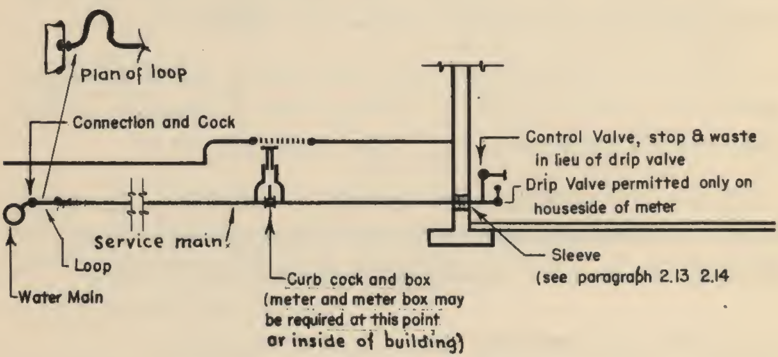


Fig. 75

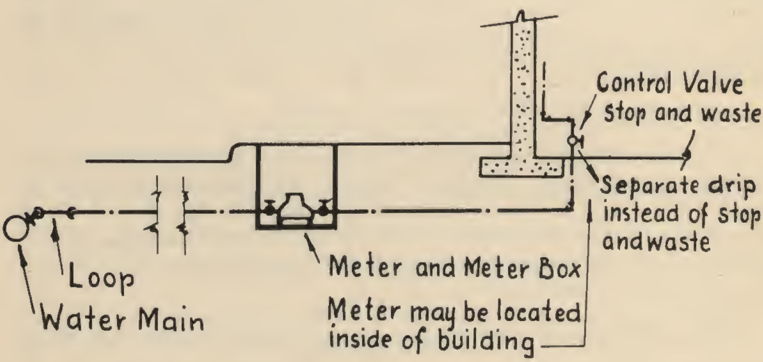


Fig. 76

10.12.2 *Tank controls*—Supply lines taken from pressure or gravity tanks shall be valved at or near their source.

10.12.3 *Separate controls for each family unit*—In two-family or multiple dwellings, each family unit shall be controlled by an arrangement of shut-off valves which permits each group of fixtures or the individual fixtures to be shut off without interference with the water supply to any other family unit or other portion of the building. [See Fig. 77.]

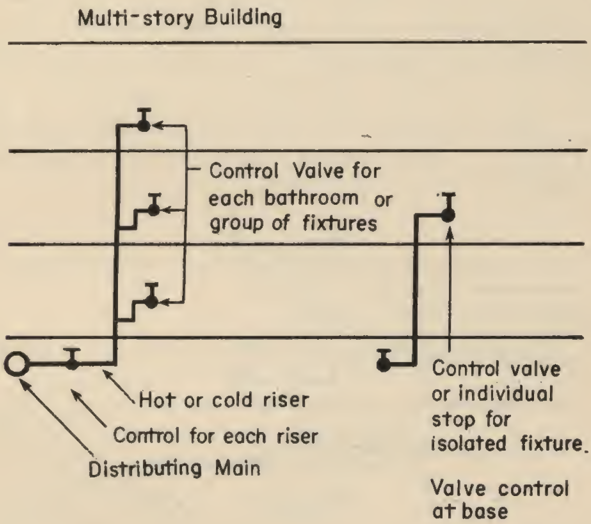


Fig. 77

10.12.4 *Group fixtures*—A group of fixtures means two or more fixtures adjacent or near each other. In a one-family house one or two bathrooms adjacent, or one over the other, may be considered a group. [See Fig. 78.]

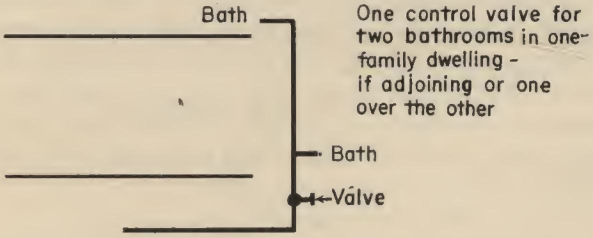


Fig. 78

10.12.5 *Buildings other than dwellings*—In all buildings other than dwellings, shut-off valves shall be installed, which permit the water supply to all equipment in each separate room to be shut off without interference with the water supply to any other room or portion of the building. [See Fig. 79.]

NOTE: Where a curb valve is not mandatory, the installation of a control valve should be made at an accessible point. In multi-story buildings, a separate control valve for hot and cold water should be provided for each apartment. The valve must be located within the tenant's apartment. When two bathrooms are adjacent in a one-family house, one control valve for hot-water supply to both bathrooms and one for cold water to both bathrooms may be used. Individual fixture stops are desirable as a convenience when **making** minor repairs.

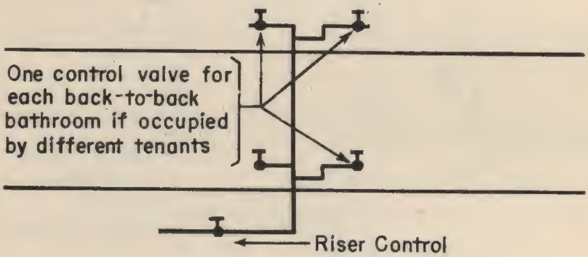


Fig. 79

10.14 PROCEDURE IN SIZING THE WATER DISTRIBUTION SYSTEM OF A BUILDING.

10.14.1 The sizing of the water distribution system shall conform to good engineering practice. Design factors used to determine pipe sizes shall be adequate in the judgment of the administrative authority. (See Appendix D for guidance in the design of water supply systems.)

NOTE: One method of sizing the water supply pipe is explained in the example given below. It is not as accurate as that based on the detailed data contained in the publications mentioned in Appendix D, but for small buildings it should provide a satisfactory basis. The data are based on results of research at the National Bureau of Standards, as reported in BMS 79. (See Bibliography.) The example is the one-story ranch house shown in Figs. 80 and 81.

Fig. 80 illustrates the plan of water distribution. Dotted figures represent the 1st-floor fixtures. Solid lines represent the basement fixtures.

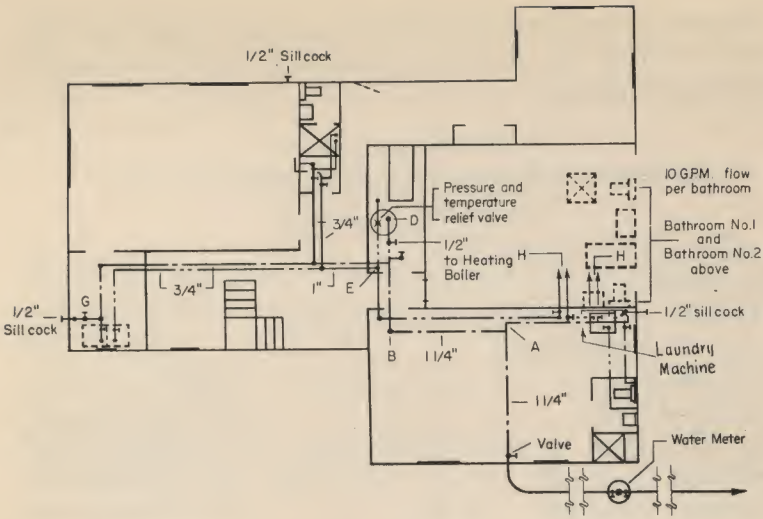


Fig. 80

Fig. 81 is a diagram of the water distribution.

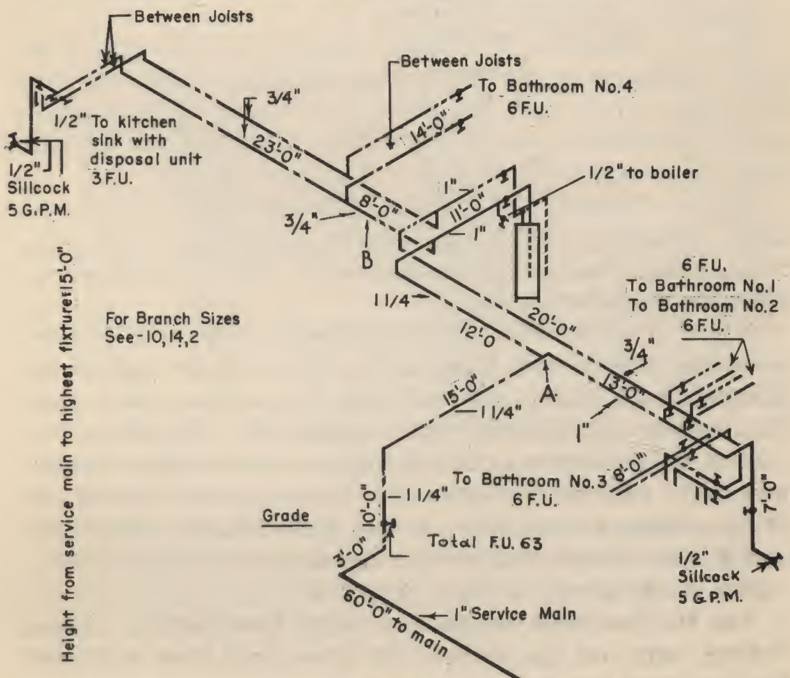


Fig. 81

Fig. 82 is a conversion table, converting plumbing fixtures to fixture-unit ratings, applicable to individual homes and small buildings.

CONVERSION TABLE
PLUMBING FIXTURES TO FIXTURE-UNIT RATINGS
Applicable to Homes

1 water closet, flush tank	= 3 fixture-units
1 lavatory	= 1 fixture-unit
1 bathtub with or without shower head	= 2 fixture-units
1 shower compartment	= 2 fixture-units
1 kitchen sink	= 2 fixture-units
1 disposal unit	= 1 fixture-unit
1 laundry trap (1 to 3-compartment)	= 3 fixture-units
1 sillcock	= 4 fixture-units
1 laundry machine	= 3 fixture-units

Source: National Plumbing Code, 1951, Appendix D, "Sizing the Water-Supply System."

Fig. 82

Sizing is computed as follows:

Step 1. Determine the water pressure at the main. The water company or the city water department has this information. Note that the water-pipe sizing table is computed to maintain a maximum velocity of 10 feet per second, based on water pressure drop of 5 psi per 100 feet.

Step 2. Compute the number of fixture-units to be supplied, including plumbing-connected appliances and sillcocks, using the conversion table (Fig. 82). In this case, there are 63 fixture-units.

Step 3. For 63 fixture-units supplied by a main of 63 feet developed length, line 11 of table (Fig. 83) is applicable. It indicates a 1-inch diameter for the service main, and 1¼-inch for the inside piping to point "A" (Fig. 81).

Step 4. Bathrooms 1, 2 and 3, plus laundry equipment and hose bibb, rate 28 fixture-units. The developed length of supply piping (point "A") is less than 50 feet, therefore Line 4 is applicable, and it recommends 1-inch diameter.

Step 5. At point "B" (Fig. 81) the fixture-unit rating is 14, and the developed length of supply piping is 45 ft. Line 1 (Fig. 83) is applicable, and it recommends ¾-inch diameter.

Step 6. Each section of piping is figured in similar manner.

Step 7. Individual fixture branches are sized according to paragraph 10.14.2.

Water-Pipe Sizing Table

Small Buildings

Sizes are computed to maintain a maximum velocity of 10 feet per second, based on water pressure drop of 5 psi per 100 feet.

Line No.	Service Main Diameter	Inside Piping Diameter	Developed Length of Piping Feet		Fixture-unit Requirements Quantity	
1	¾″	¾″	Maximum	50 ft.	Maximum	25 F.U.
2	¾″	¾″	"	100 ft.	"	16 F.U.
3	¾″	¾″	"	150 ft.	"	15 F.U.
4	¾″	1″	"	50 ft.	"	40 F.U.
5	¾″	1″	"	100 ft.	"	33 F.U.
6	¾″	1″	"	150 ft.	"	28 F.U.
7	1″	1″	"	50 ft.	"	50 F.U.
8	1″	1″	"	100 ft.	"	40 F.U.
9	1″	1″	"	150 ft.	"	30 F.U.
10	1″	1¼″	"	50 ft.	"	96 F.U.
11	1″	1¼″	"	100 ft.	"	65 F.U.
12	1″	1¼″	"	150 ft.	"	55 F.U.
13	1¼″	1¼″	"	50 ft.	"	150 F.U.
14	1¼″	1¼″	"	100 ft.	"	100 F.U.
15	1¼″	1¼″	"	150 ft.	"	65 F.U.
16	1¼″	1½″	"	50 ft.	"	250 F.U.
17	1¼″	1½″	"	100 ft.	"	160 F.U.
18	1¼″	1½″	"	150 ft.	"	130 F.U.

Source: BMS 79, *Water-Distributing Systems for Buildings.*

Fig. 83

Fig. 84 is a table of pipe sizes for multi-story apartment buildings. It is a simplified basis for figuring mains, risers or branches for combined hot and cold water supply as well as for separate hot or cold water supply piping.

Pipe sizes are computed for average distances and average water pressures in a large building.

This table is based on recommendations given in report BMS 79, a report on *Water-Distribution Systems for Buildings.*

Table of water pipe sizes

BASED ON FLUSH TANKS

No. of Apts	Cold & Hot Water Combined Fixture Units	G.P.M.	Pipe Size Copper	Pipe Size Galv	COLD WATER Fixture Units	G.P.M.	Pipe Size Copper	Pipe Size Galv	HOT WATER Fixture Units	G.P.M.	Pipe Size Copper	Pipe Size Galv
			Inches				Inches				Inches	
1	8	7	3/4	3/4	6	5	3/4	3/4	4.5		1/2	3/4
2	16	12	3/4	1	12	8	3/4	3/4	9	7	3/4	3/4
3	24	17	1	1 1/4	18	13	1	1	13.5	10	3/4	1
4	32	21	1	1 1/4	24	17	1	1 1/4	18	13	1	1
5	40	24	1 1/4	1 1/4	30	20	1	1 1/4	22.5	16	1	1 1/4
6	48	28	1 1/4	1 1/2	36	23	1 1/4	1 1/4	27	18	1	1 1/4
7	56	32	1 1/4	1 1/2	42	25	1 1/4	1 1/4	31.5	21	1	1 1/4
8	64	34	1 1/2	1 1/2	48	28	1 1/4	1 1/2	36	23	1 1/4	1 1/4
9	72	36	1 1/2	1 1/2	54	30	1 1/4	1 1/2	40.5	25	1 1/4	1 1/4
10	80	38	1 1/2	1 1/2	60	32	1 1/4	1 1/2	45	27	1 1/4	1 1/2
11	88	41	1 1/2	2	66	35	1 1/2	1 1/2	49.5	28	1 1/4	1 1/2
12	96	43	1 1/2	2	72	37	1 1/2	1 1/2	54	30	1 1/4	1 1/2
13	104	45	1 1/2	2	78	38	1 1/2	1 1/2	58.5	32	1 1/4	1 1/2
14	112	47	1 1/2	2	84	40	1 1/2	1 1/2	63	33	1 1/4	1 1/2
15	120	48	1 1/2	2	90	41	1 1/2	2	67.5	35	1 1/2	1 1/2
16	128	50	1 1/2	2	96	43	1 1/2	2	72	36	1 1/2	1 1/2
17	136	52	1 1/2	2	102	44	1 1/2	2	76.5	38	1 1/2	1 1/2
18	144	54	2	2	108	46	1 1/2	2	81	40	1 1/2	1 1/2
19	152	55	2	2	114	47	1 1/2	2	85.5	41	1 1/2	1 1/2
20	160	57	2	2	120	48	1 1/2	2	90	42	1 1/2	2
21	168	59	2	2	126	50	1 1/2	2	94.5	43	1 1/2	2
22	176	60	2	2	132	51	1 1/2	2	99	44	1 1/2	2
23	184	62	2	2	138	52	1 1/2	2	103.5	45	1 1/2	2
24	192	63	2	2	144	53	2	2	108	46	1 1/2	2
25	200	65	2	2	150	55	2	2	112.5	47	1 1/2	2
26	208	67	2	2	156	56	2	2	117	48	1 1/2	2
27	216	68	2	2	162	57	2	2	121.5	49	1 1/2	2
28	224	70	2	2	168	58	2	2	126	50	1 1/2	2
29	232	72	2	2	174	60	2	2	130.5	51	1 1/2	2
30	240	73	2	2	180	61	2	2	135	52	1 1/2	2
31	248	74	2	2	186	63	2	2	139.5	53	2	2
32	256	76	2	2	192	64	2	2	144	54	2	2
33	264	78	2	2	198	65	2	2	148.5	55	2	2
34	272	80	2	2	204	66	2	2	153	56	2	2
35	280	82	2	2	210	67	2	2	157.5	57	2	2
36	288	83	2	2	216	68	2	2	162	58	2	2
50	400	106	2	2	300	85	2	2	225	70	2	2
100	800	179	2 1/2	2 1/2	600	144	2 1/2	2 1/2	450	115	2	2
150	1200	234	3	3	900	194	2 1/2	2 1/2	675	157	2 1/2	2 1/2
200	1600	283	3	3	1200	234	3	3	900	194	2 1/2	2 1/2
250	2000	327	3	3	1500	270	3	3	1125	224	3	3

Fig. 84

In addition to the information contained in Appendix D

of the Report of the Coordinating Committee for a National Plumbing Code, the following publications also provide data on sizing the water supply system. *Water Supply Piping for Plumbing Systems,* by F. M. Dawson and A. S. Kalinske; *American Standards Association Plumbing Code* (ASA A40.7). (See Bibliography for further details.)

The National Association of Master Plumbers and the Housing and Home Finance Agency are currently conducting extensive studies entitled "Noise in the Water Supply System," as well as studies regarding over-all design of the water supply system. When completed, reports of these studies will be available.

10.14.2 *Size of fixture supply*—The minimum size of a fixture-supply pipe shall be as follows:

Type of fixture or device:	*Pipe size (inch)*
Bathtubs	½
Combination sink and tray	½
Drinking fountain	⅜
Dishwasher (domestic)	½
Kitchen sink, residential	½
Kitchen sink, commercial	¾
Lavatory	⅜
Laundry tray, 1, 2, or 3 compartments	½
Shower (single head)	½
Sinks(service, slop)	½
Sinks, flushing rim	¾
Urinal (flush tank)	½
Urinal (direct flush valve)	¾
Water closet (tank type)	⅜
Water closet (flush valve type)	1
Hose bibbs	½
Wall hydrant	½

For fixtures not listed, the minimum supply branch may be made the same as for a comparable fixture.

10.16 Safety devices.

10.16.1 *Pressure-relief valves*—Pressure-relief valves shall be installed for all equipment used for the heating or storage of hot water. The rate of discharge of such a valve shall limit the pressure rise for any given heat input to 10% of the pressure at which the valve is set to open.

Note: For example, a valve set to relieve at 90 pounds per square inch might override to 99 pounds per square inch.

The relief valve should be set so that during the time thermal expansion is taking place, the pressure will not rise above the predetermined maximum.

10.16.2 *Temperature-relief valves*—Temperature-relief valves shall be installed for all equipment used for the heating or storage of hot water. Each valve shall be rated as to its Btu capacity. At 210 degrees F., it shall be capable of discharging sufficient hot water to prevent any further rise in temperature.

NOTE: This type of relief valve must prevent a rise in temperature above 212 degrees F. It should therefore be large enough to take care of the heat input of the heater. Furthermore, the relieving capacity of a temperature-relief valve should not be less than 1 gallon of water per hour for each 1,250 Btu of heater capacity per hour. Many explosions have been due not to lack of a relief valve on a hot water tank, but to failures of the relief valve, such as faulty operation, improper location, insufficient size, or poor construction. Both the pressure-relief valve and the temperature-relief valve must be provided with a drain connection equal in diameter to the valve discharge outlet. Also, the end of the drain-off should be located so that there is no danger of scalding a person near the appliance. Also the drain-off should be located where it would not damage the plumbing fixture.

See Figs. 85 to 90 inclusive for recommended locations of pressure-relief valves and temperature-relief valves.

Wherever a temperature-relief valve or a combination temperature-and-pressure relief valve is installed, it is pref-

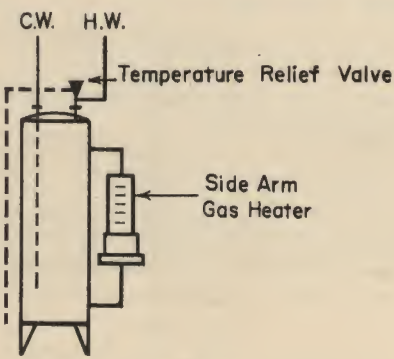


Fig. 85

erable that the valve stem or thermal element extend into the tank. In no case should it be more than 6 inches from the top of the tank. The element should be in direct contact with the hot water flow.

If pressure-relief valves are used separate from temperature-relief valves, the pressure-relief valve should be placed either on the hot or the cold water piping, as near to the tank as possible.

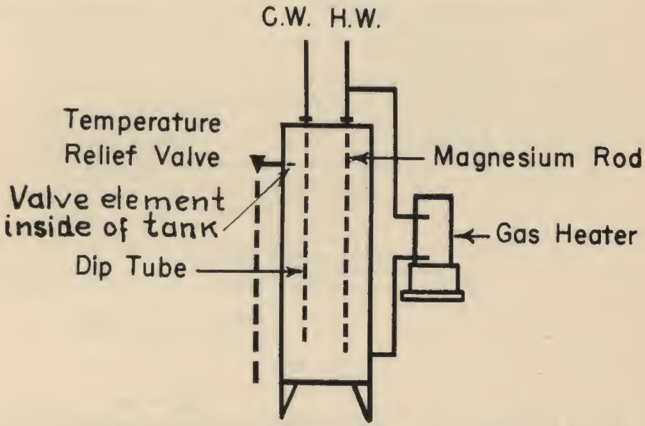


Fig. 86

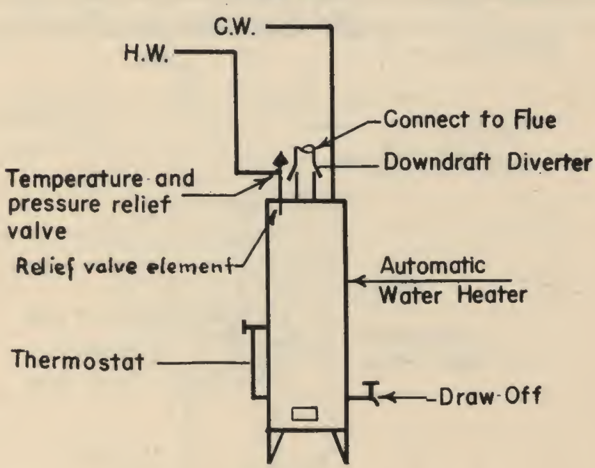


Fig. 87

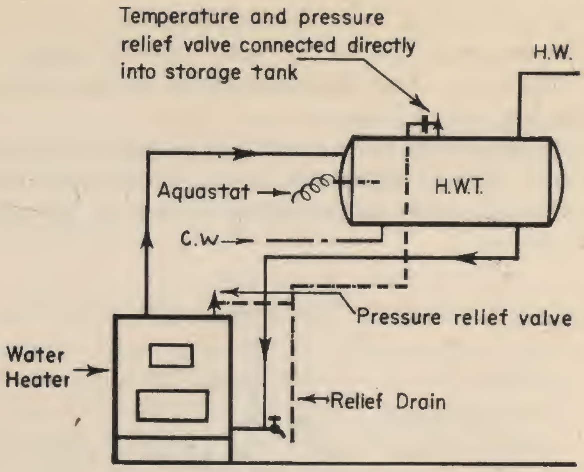


Fig. 88

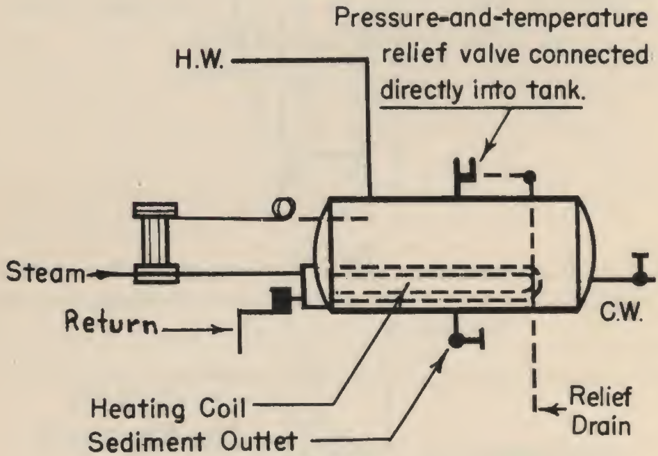


Fig. 89

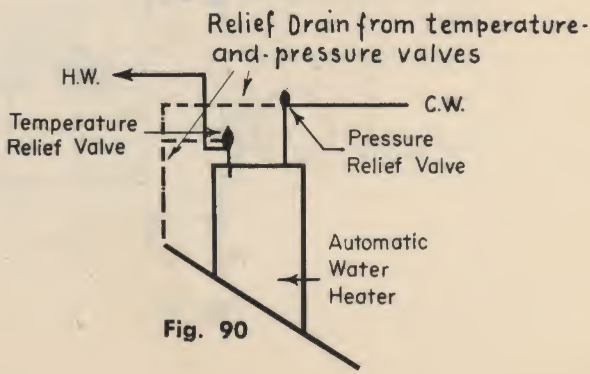


Fig. 90

11.2 Building sewer.

11.2.1 *Separate trenches*—The building sewer, when installed in a separate trench from the water-service pipe, shall be cast-iron sewer pipe, vitrified-clay sewer pipe, concrete sewer pipe, bituminized-fiber sewer pipe, or asbestos-cement sewer pipe. Joints shall be watertight and rootproof. [See Fig. 91.]

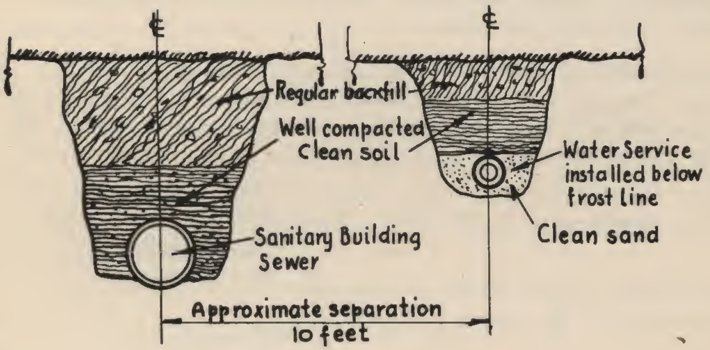


Fig. 91

11.2.2 *One trench*—The building sewer, when installed in the same trench with the water-service pipe, shall be constructed of durable materials which are corrosion-resistant and shall be so installed as to remain watertight and be rootproof. The building sewer shall be tested with a 10-foot head of water or equivalent and found to be tight.

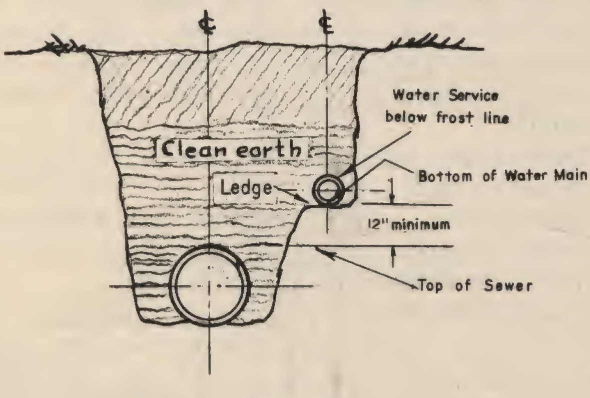


Fig. 92

11.2.3 *Sewer in filled ground*—A building sewer or building drain installed in filled or unstable ground shall be of cast-iron pipe, except that nonmetallic drains may be laid upon an approved concrete pad if installed in accordance with paragraph 11.2.1.

NOTE: Regarding the provision "that nonmetallic drains may be laid upon an approved concrete pad," the necessity for a concrete pad under the piping arises only when the nonmetallic drains are to be installed in filled-in, unstable ground under the building.

11.2.4 *Sanitary and storm sewers*—Where separate systems of sanitary drainage and storm drainage are installed in the same property the sanitary and storm building sewers or drains may be laid side by side in one trench.

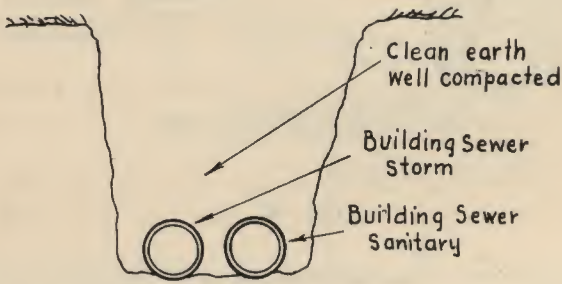


Fig. 93

NOTE: The building sewer, when installed in a trench *separate* from the water-service pipe, as in Fig. 91, may be constructed of any of the following kinds of pipe:

(a) Cast-iron soil pipe (either extra-heavy or service weight).
(b) Vitrified-clay pipe (cement mortar, hot-poured or precast joints).
(c) Concrete sewer pipe (cement mortar, hot-poured or precast joints).
(d) Bituminized-fiber pipe (taper joints).
(e) Asbestos-cement pipe (rubber rings joints).

The use of either extra-heavy or service-weight cast-iron soil pipe is satisfactory, but standard-weight pipe may not be installed in buildings over two stories in height. Cast-iron soil pipe has recently been standardized to two weights, extra-heavy and service-weight.

The building sewer, when installed in the *same* trench with the water-service pipe, as in Fig. 92, shall be constructed of durable materials which are corrosion-resistant, and shall be installed so as to remain watertight and root resistant. The following conditions must be met:

(a) The water-service pipe must be installed at least 12 inches above the top level of the building sewer pipe.

(b) The water-service pipe must be placed on a solid shelf at the side of the trench.

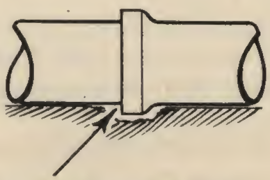
(c) The water-service pipe should be in one piece, between the building and the water main.

(d) The building sewer may be of any of the following kinds of pipe: extra-heavy cast-iron soil pipe with hot-poured lead joints; vitrified-clay pipe with hot-poured joints or precast joints as described in paragraphs 4.2.6, 4.2.7, 4.2.11 and 4.2.12.

(e) The building sewer shall be tested after installation with not less than a 10-foot head of water or by means of an equivalent test.

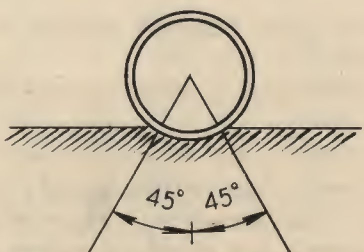
Fig. 94 shows excavation necessary under pipe bell.

Fig. 95 shows pipe barrel in firm contact with solid ground.



Excavate no more than necessary to clear pipe bell

Fig. 94



Bottom of pipe barrel, including 45° Arc from center, should be in firm contact with solid ground.

Fig. 95

NOTE: The following publications give information pertaining to piping for the domestic house sewer or for the line from a septic tank to a disposal field.

Clay Pipe Engineering Manual, Clay Pipe Industry.

Report on Investigation of Orangeburg Pipe for Sewer, W. E. Stanley, Orangeburg Manufacturing Company, 488 Madison Avenue, New York 22, New York.

Underground Corrosion, R. H. Logan, National Bureau of Standards, Circular C450, U. S. Department of Commerce, Washington 25, D. C.

11.3 DRAINAGE PIPING INSTALLATION.

11.3.1 *Horizontal drainage piping*—Horizontal drainage piping shall be installed at a uniform slope but at slopes not less than permitted in paragraphs 11.3.2, 11.3.3, and 11.3.4.

11.3.2 *Small piping*—Horizontal drainage piping of 3-inch diameter and less shall be installed with a fall of not less than ¼-inch per foot.

11.3.3 *Large piping*—Horizontal drainage piping of larger than 3-inch diameter shall be installed with a fall of not less than ⅛-inch per foot.

11.3.4 *Minimum velocity*—Where conditions do not permit building drains and sewers to be laid with a fall as great as that specified, then a lesser slope may be permitted provided the computed velocity will not be less than 2 fps.

NOTE: Fig. 96 gives data on the approximate flow velocities of sewage for given slopes and pipe diameters. The table is taken from BMS 66 (see Bibliography).

FLOW VELOCITIES

Dia. of pipe inches	1/16" fall/ft. fps	⅛" fall/ft. fps	¼" fall/ft. fps	½" fall/ft. fps.
1¼			1.61	2.28
1½		1.24	1.76	2.45
2	1.02	1.44	*2.03*	2.88
2½	1.14	1.61	2.28	3.23
3	1.24	1.76	2.49	3.53
4	1.44	*2.03*	2.88	4.07
5	1.61	2.28	4.23	4.56
6	1.76	2.49	3.53	5.00
8	*2.03*	2.88	4.07	5.75
10	2.28	3.23	4.56	6.44

Fig. 96

Higher velocities, or greater fall-per-foot, increase the carrying capacity of the building drain. It is a good policy to design for the highest possible velocity, as it will tend to keep the drain pipe clean. When designing fixture branches, however, it should be borne in mind that high velocities in pipes with slopes greater than ¼-inch per foot can cause siphonage of the trap seal.

House trap and fresh air inlet—The National Plumbing Code does not require the installation of a house trap and fresh air inlet. However, in those cities where house traps are required and a new building is being constructed among old buildings that have house traps, it is not desirable to leave out the house trap and fresh air inlet in the new building. But where a new community is being planned, the house trap and fresh air inlet may be omitted.

Fig. 97 illustrates the installation of a house trap and fresh air inlet. The house trap may be installed in a concrete pit with cover, or the cleanouts may be brought up to the finished floor. The fresh air inlet may be terminated with a return bend, or if located inside, it may be terminated at the outside front wall with a grate. When a grate is used, install a check or flap which will open readily as an air intake, but will not permit a downdraft to blow foul odor into the street.

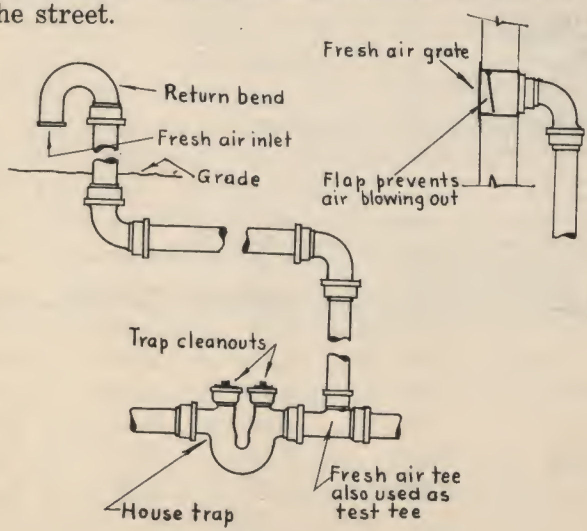


Fig. 97

11.4 FIXTURE-UNITS.

11.4.1 *Values for fixtures* — Fixture-unit values as given in table 11.4.2 designate the relative load weight of different kinds of fixtures which shall be employed in estimating the total load carried by a soil or waste pipe and shall be used in connection with the tables of sizes for soil, waste, and drain pipes for which the permissible load is given in terms of fixture-units.

TABLE 11.4.2 *Fixture units per fixture or group*

Fixture type	Fixture-unit value as load factors	Minimum size of trap (inches)
1 bathroom group consisting of water closet, lavatory, and bathtub or shower stall.	Tank water closet 6 Flush-valve water closet 8	
Bathtub [1] (with or without overhead shower)	2	1½
Bathtub [1]	3	2
Bidet	3	Nominal 1½
Combination sink-and-tray	3	1½
Combination sink-and-tray with food-disposal unit	4	Separate traps 1½
Dental unit or cuspidor	½	1¼
Dental lavatory	1	1¼
Drinking fountain	½	1
Dishwasher,[2] domestic	2	1½
Floor drains [3]	1	2
Kitchen sink, domestic	2	1½
Kitchen sink, domestic, with food-disposal unit	3	1½
Lavatory [4]	1	Small P. O. 1¼
Do	2	Large P. O. 1½
Lavatory, barber, beauty parlor	2	1½
Lavatory, surgeon's	2	1½
Laundry tray (1 or 2 compartments)	2	1½
Shower stall, domestic	2	2
Showers (group) per head [2]	3	
Sinks:		
Surgeon's	3	1½
Flushing rim (with valve)	8	3
Service (Trap standard)	3	3
Service (P trap)	2	2
Pot, scullery, etc.[2]	4	1½
Urinal, pedestal, syphon jet, blowout	8	Nominal 3
Urinal, wall lip	4	1½
Urinal stall, washout	4	2
Urinal trough [2] (each 2-foot section)	2	1½
Wash sink [2] (circular or multiple), each set of faucets	2	Nominal 1½
Water closet:		
Tank-operated	4	Nominal 3
Valve-operated	8	3

[1] A shower head over a bathtub does not increase the fixture value.

[2] See pars. 11.4.3 and 11.4.4 for method of computing unit value of fixtures not listed in table 11.4.2 or for rating of devices with intermittent flows.

[3] Size of floor drain shall be determined by the area of surface water to be drained.

[4] Lavatories with 1¼- or 1½-inch traps have the same load value; larger P. O. plugs have greater flow rate.

11.4.3 Fixtures not listed in table 11.4.2 shall be estimated in accordance with table 11.4.3.

TABLE 11.4.3

Fixture drain or trap size	Fixture-unit value	Fixture drain or trap size	Fixture-unit value
1¼ inches and smaller	1	2½ inches	4
1½ inches	2	3 inches	5
2 inches	3	4 inches	6

11.4.4 *Valves for continuous flow*—For a continuous or semi-continuous flow into a drainage sytem, such as from a pump, pump ejector, air-conditioning equipment, or similar device, two fixture-units shall be allowed for each gallon-per-minute of flow.

Those who are interested in tracing the mathematical origin of these tables, and verifying the conclusions for themselves, will find the best assistance in a paper entitled *Housing Research Paper No. 15, Fixture-Unit Ratings as Used in Plumbing System Design,* by Herbert N. Eaton and John L. French of the Hydraulics Laboratory, National Bureau of Standards.

It is difficult to rate all plumbing fixtures in accordance with table 11.4.2 because of the large number of fixtures made for special purposes, such as printers' sinks, laboratory sinks, and special hospital fixtures. Special purpose fixtures may be rated by the size of the trap recommended by the manufacturer. Eventually, all manufacturers of fixtures and appliances will indicate the fixture-unit value on their products. In the meantime, table 11.4.3 provides an approximate rating of those fixtures not rated in table 11.4.2.

NOTE: Fig. 98 illustrates sizing for an intermittent flow from a sump pump. The building has five soil stacks. Stacks Nos. 1, 2 and 5 contain public-type fixtures. Stacks Nos. 3 and 4 contain private-type fixtures. The total fixture-units for each stack are given.

Each stack is sized according to table 11.5.3. Horizontal branches from the base of a stack to the building drain are the same size as the building drain (table 11.5.2) and the building drain is then sized according to its fall per foot.

The discharge from the sump is converted into fixture-unit values by multiplying the number of gallons flow by 2. It is recommended, however, where the discharge from the sump is connected to the building drain, that there be no connections from the gravity system for at least 10 feet downflow from the sump connection. If this is impractical, the building drain should be increased one pipe size. This prevents a heavy load concentration which could affect the fixtures on the lower floor where the stack is connected close to the sump discharge.

It would be preferable to connect large flows from the sump close to the point where the building drain leaves the building. Where the discharge is from pneumatic ejectors, or where heavy and abrupt discharges are to be expected, the discharge should be carried separately to the building sewer just outside the building wall.

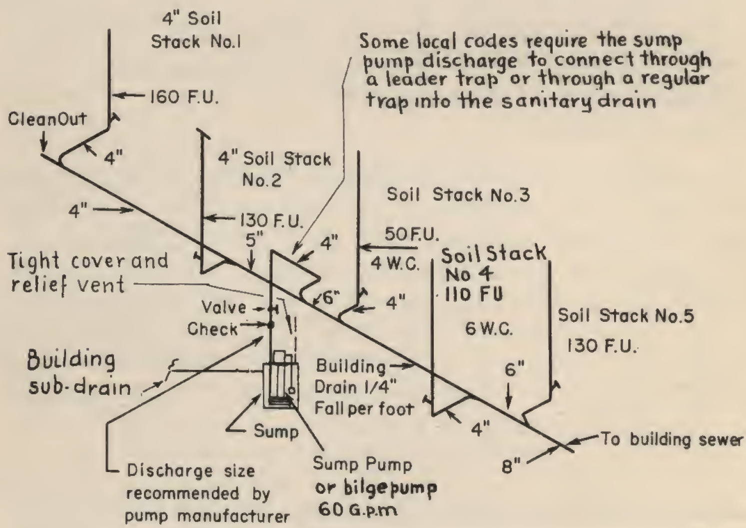


Fig. 98

Fig. 99 illustrates another example of continuous flow rate. The number of fixture-unit equivalents to a sump pump discharging 100 gallons per minute is 200 fixture-units. According to table 11.5.2, the drain may be sized as follows:

Sizing of Drain
Example: Fig. 99

Slope: ⅛ inch fall per foot			Slope: ¼ inch fall per foot		
Location	*Number of fixture-units*	*Diameter of drain*	*Location*	*Number of fixture-units*	*Diameter of drain*
Point A	200	5 inches	Point A	200	4 inches
Point B	350	5 inches	Point B	350	5 inches
Point C	500	6 inches	Point C	500	6 inches
Point D	650	6 inches	Point D	650	6 inches
Point E	800	8 inches	Point E	800	6 inches

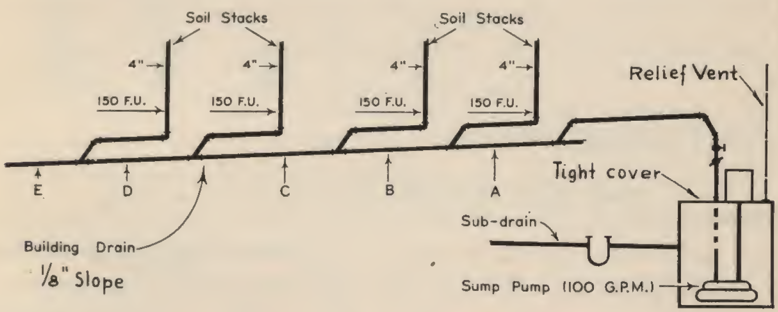


Fig. 99

NOTE: It is desirable that the slope of the building drain be maintained uniformly throughout its length. If this is impractical, select a pipe size which provides for velocities of not less than 2 feet per second. (See Fig. 96.)

Horizontal piping from a branch to a group of fixtures on the same level as the building drain should be the same as for the building drain. (Paragraph 11.5.2.)

A 3-inch building drain is large enough to serve 2 water closets, plus whatever additional fixtures are desired provided the total number of fixture-units does not exceed the maximum permitted in table 11.5.2. Blow-out type urinals are classified as water closets in computing the size of the building drain. The reason for this is that a blow-out urinal will discharge as much water as a regular water closet in the same time.

11.5 DETERMINATION OF SIZES FOR THE DRAINAGE SYSTEM.

11.5.1 *Maximum fixture-unit load*—The maximum number of fixture-units that may be connected to a given size of building sewer, building drain, horizontal branch, or vertical soil or waste stack is given in tables 11.5.2 and 11.5.3.

TABLE 11.5.2 *Building drains and sewers*

Diameter of pipe (inches)	Maximum number of fixture units that may be connected to any portion [1] of the building drain or the building sewer			
	Fall per foot			
	1/16-inch	1/8-inch	1/4-inch	1/2-inch
2			21	26
2½			24	31
3		[2] 20	[2] 27	[2] 36
4		180	216	250
5		390	480	575
6		700	840	1,000
8	1,400	1,600	1,920	2,300
10	2,500	2,900	3,500	4,200
12	3,900	4,600	5,600	6,700

[1] Includes branches of the building drain.
[2] Not over 2 water closets.

TABLE 11.5.3 *Horizontal fixture branches and stacks*

Diameter of pipe (inches)	Maximum number of fixture units that may be connected to—			
	Any horizontal [1] fixture branch	1 stack of 3 stories in height or 3 intervals	More than 3 stories in height	
			Total for stack	Total at 1 story or branch interval
1¼	1	2	2	1
1½	3	4	8	2
2	6	10	24	6
2½	12	20	42	9
3	[2] 20	[3] 30	[3] 60	[3] 16
4	160	240	500	90
5	360	540	1,100	200
6	620	960	1,900	350
8	1,400	2,200	3,600	600
10	2,500	3,800	5,600	1,000
12	3,900	6,000	8,400	1,500

[1] Does not include branches of the building drain.
[2] Not over 2 water closets.
[3] Not over 6 water closets.

11.5.4 *Minimum size of soil and waste stacks*—No soil or waste stack shall be smaller than the largest horizontal branch connected thereto except that a 4 × 3 W. C. connection shall not be considered as a reduction in pipe size.

11.5.5 *Minimum size of stack vent or vent stack*—Any structure in which a building drain is installed shall have at least one vent stack carried full size through the roof not less than 3 inches in diameter or the size of the building drain, whichever is the lesser.

NOTE: Fig. 100 illustrates a one-story row house containing four dwelling units with the building drain underground.

In section (a) the water closet is stack vented; the bathtub is wet vented through the lavatory; the sink and dishwasher have a common vent. See paragraph 12.10.2 for sizing when one plumbing fixture connects below the other. If both plumbing fixtures connect at the same level, the vertical waste is sized according to table 11.4.2 for the total number of fixture-units; in this case, there are 4 fixture-units, which require a 1½-inch waste.

In section (b) the water closet is stack vented; the bathtub is wet vented through the lavatory waste; the sink and food-waste grinder have a common vent. The vertical waste below the sink connection is sized 2 inches, according to paragraph 12.10.2. If both fixtures are connected at the same level, the vertical waste is 2 inches, because the total number of fixture-units is 5.

All fixtures in (c) are stack vented except the sink, which is individually vented or back vented. The back vent is 1¼ inches because the sink represents only 2 fixture-units. The stack here must be 3 inches up to the highest fixture connection.

In section (d) all fixtures are stack vented, and regardless of climate the soil stack *must* be extended full-size 3-inch diameter through the roof as a stack vent.

The building drain is sized according to table 11.5.2, and cleanouts are provided according to paragraph 5.4.1. Branches for connecting plumbing fixtures are vented at the distances provided in table 12.9.3. The slope at which

a branch is roughed should not exceed one pipe diameter (see paragraph 12.9.4).

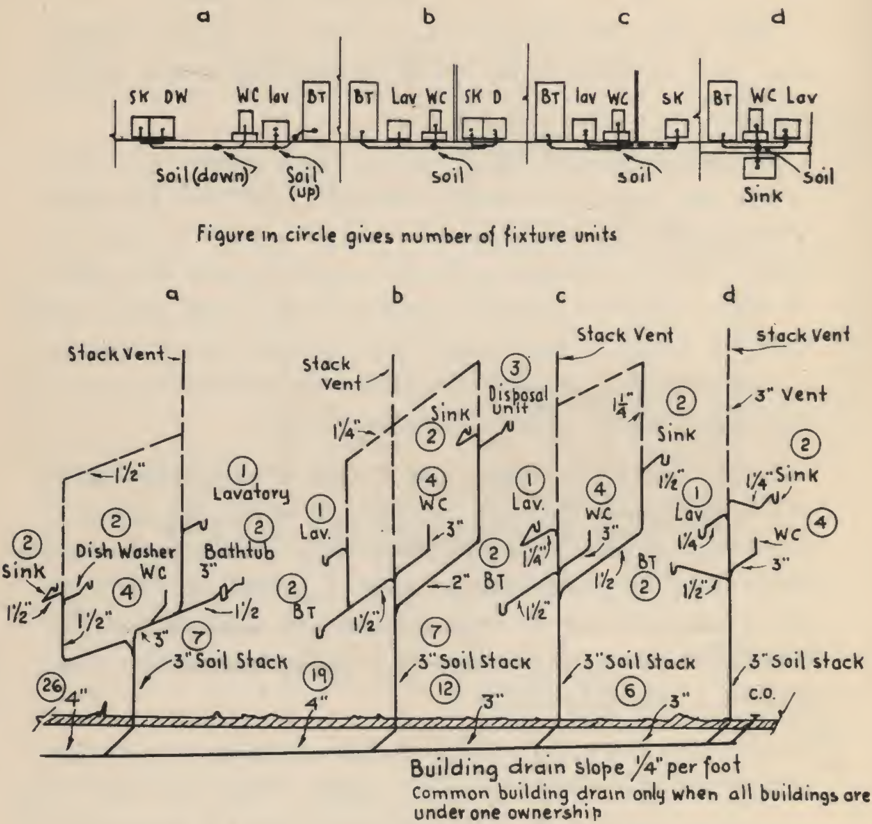


Fig. 100

There are other ways of wet venting a fixture which cannot be provided with a continuous or back vent. The principle of wet venting may be applied to a floor drain, a dental unit, or any other fixture which must be installed in the middle of a room and cannot be individually vented.

The advantage of wet venting is that it insures a clear vent. There is no assurance that a back vent installed horizontally will remain open and effective, nor is there any way of knowing when it becomes clogged.

Fig. 101 shows wet venting of dental units.

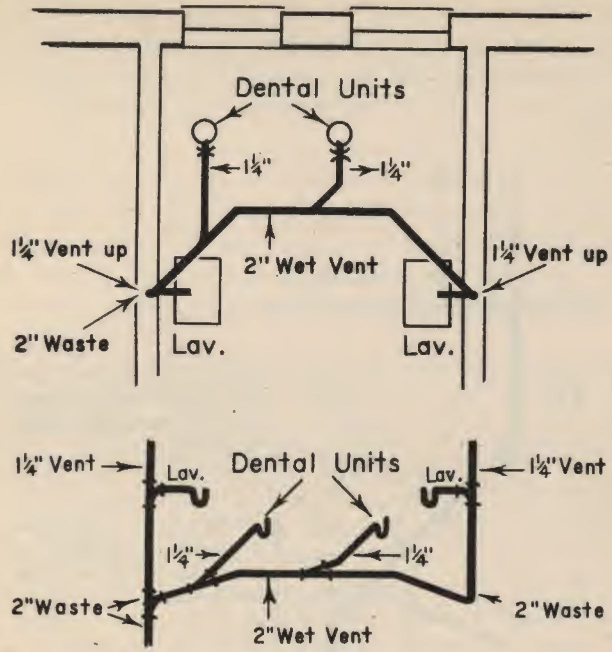


Fig. 101

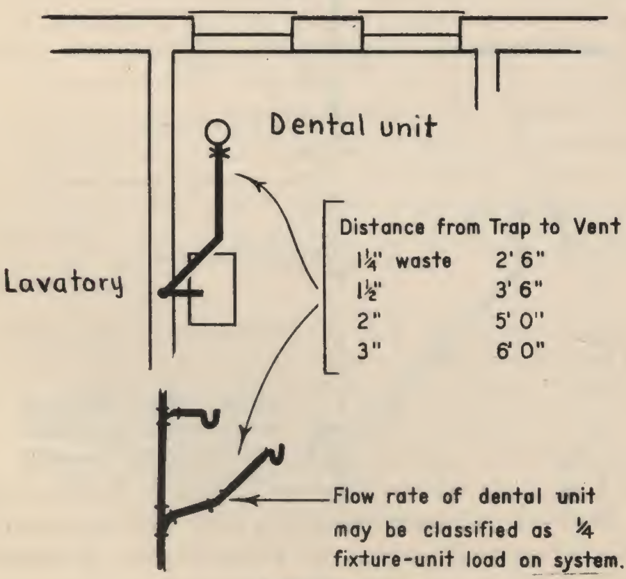


Fig. 102

Fig. 102 illustrates a single dental unit wet vented through a lavatory. The length of the unvented branch depends on the diameter of the branch waste installed. The flow rate of a dental unit is so small that possibility of self-siphonage of the trap under ordinary use is remote.

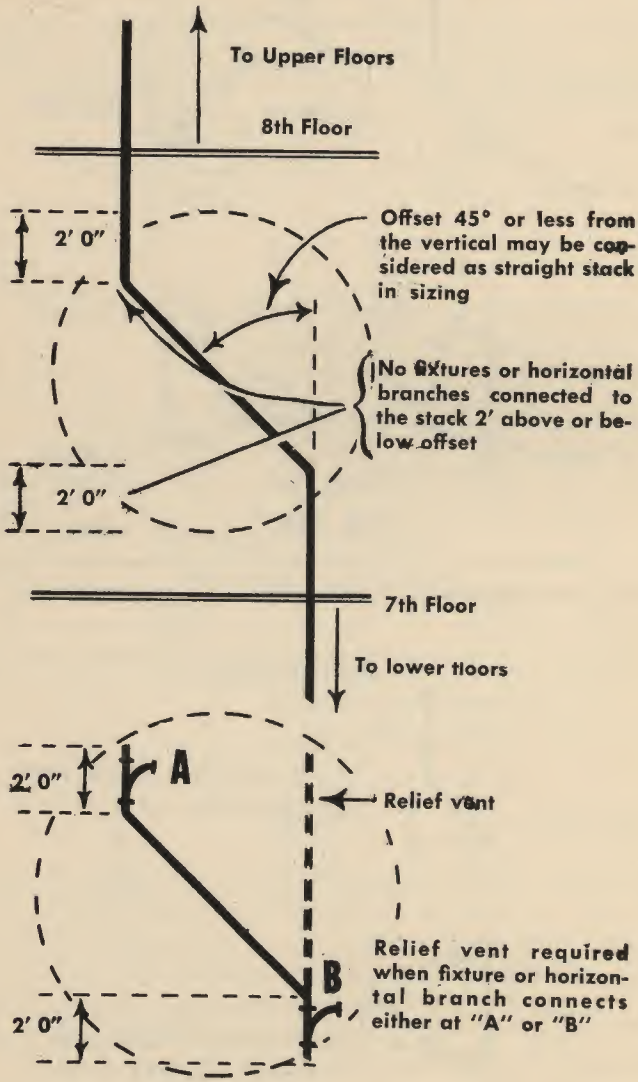


Fig. 103

11.6 OFFSETS ON DRAINAGE PIPING.

11.6.1 *Offsets of 45 degrees or less*—An offset in a vertical stack with a change of direction of 45 degrees or less from the vertical may be sized as a straight vertical stack. In case a horizontal branch connects within 2 feet above or below the offset, a relief vent shall be installed in accordance with paragraph 12.18.3.

NOTE: Fig. 103—The relief vent may be installed either as a vertical continuation of the lower section of the stack, or as a side vent connected to the lower section between the offset and the next lower fixture or horizontal branch. The diameter of the relief vent must be no less than the diameter of the main vent or the soil or waste stack, whichever is the smaller.

Offsets of 45 degrees or less do not seriously affect the flow in the stack. Table 11.5.3 provides for loading of stacks not more than ½ full at any point. This partial loading is a safety factor. When a horizontal load is imposed at this point, then the relief vent is necessary in order to prevent excess pressures from affecting operation of the fixtures connected to the branch.

11.6.3 *Above highest branch*—An offset above the highest horizontal branch is an offset in the stack vent and shall be considered only as it affects the developed length of the vent.

NOTE: Fig. 104—Offsets occurring above the highest fixture or horizontal branch are part of the stack vent and do not affect the capacity of the stack. The vent at this point is of sufficient diameter to provide for air circulation.

11.6.4 *Below lowest branch*—In the case of an offset in a soil or waste stack below the lowest horizontal branch, no change in diameter of the stack because of the offset shall be required if it is made at an angle of not greater than 45 degrees. If such an offset is made at an angle greater than 45 degrees, the required diameter of the offset and the stack below it shall be determined as for a building drain. [See table 11.5.2.]

NOTE: Fig 105 illustrates an offset below the lowest horizontal branch. A 45-degree offset will not aflect the size of the pipe, regardless of where such an offset occurs in the soil or waste stack. But if the offset is in a horizontal position (see definition of horizontal pipe), it is necessary to increase the diameter of the offset pipe.

This is done to avoid developing pressure or vacuum which will disturb the trap seal of the lower fixture. Such threatening condition becomes more serious as the load in the

stack is increased. The most critical area is at the base of the stack or at the lowest floor in a building, especially when an offset or change of direction occurs immediately below a plumbing fixture. A plumbing fixture should not be installed nearer than 2 feet from the offset.

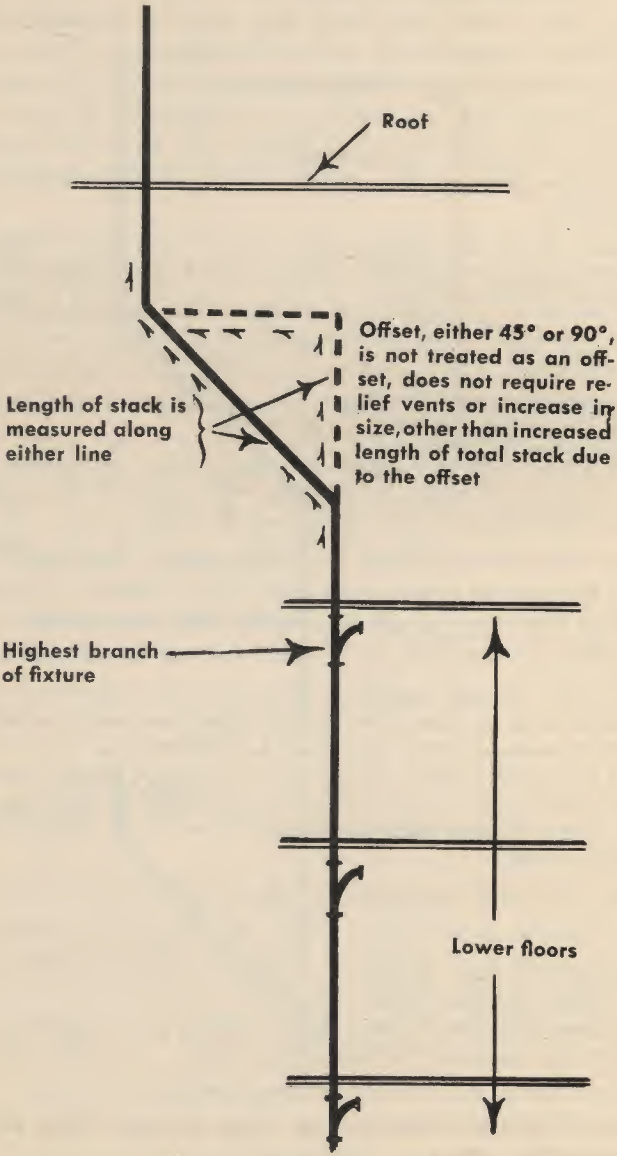


Fig. 104

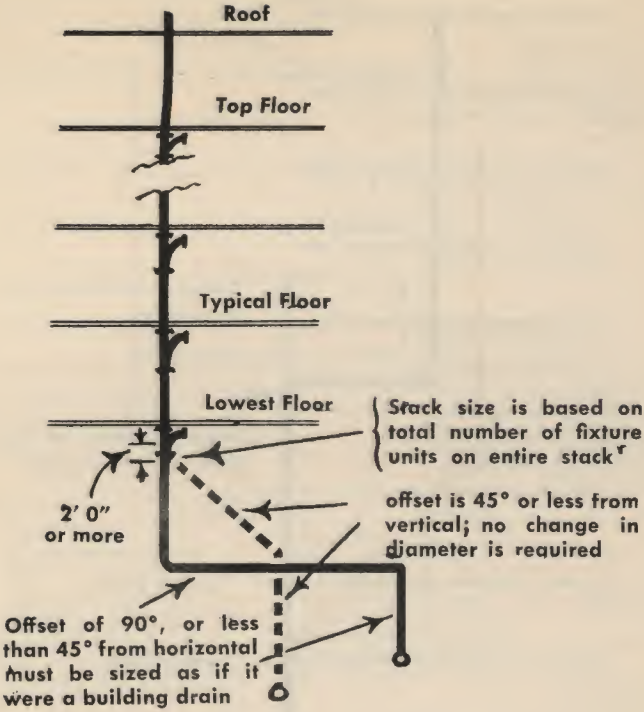


Fig. 105

11.6.5 *Offsets of more than 45°*—A stack with an offset of more than 45° from the vertical shall be sized as follows:

The portion of the stack above the offset shall be sized as for a regular stack based on the total number of fixture units above the offset.

The upper portion of the stack above the offset shall be sized as for a building drain. [See table 11.5.2, column 5.]

The portion of the stack below the offset shall be sized as for the offset or based on the total number of fixture units on the entire stack, whichever is the larger. [See table 11.5.3, column 4.]

A relief vent for the offset shall be installed as provided in chapter 12 and in no case shall the horizontal branch connect to the stack within 2 feet above or below the offset.

NOTE: Fig. 106 illustrates an offset of more than 45°—in this case a 90° offset.

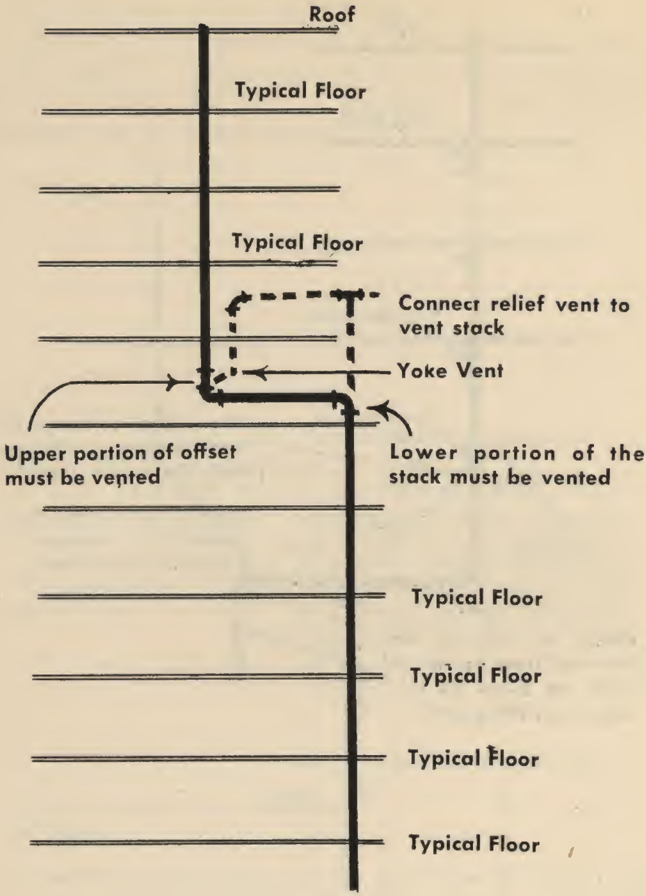


Fig. 106

Fig. 107 illustrates the sizing of a stack in a 12-story building where there is one offset between the fifth and sixth floors and another offset below the street floor.

Sizing is computed as follows:

Step 1: Compute the fixture-units connected to the entire stack. In this case, assume there are 1200 fixture-units connected to stack from street floor through top floor.

Step 2: Size the portion of stack above the fifth-floor offset. There are 400 fixture-units from the top floor down through the sixth floor. According to table 11.5.3, column "Total for stack," 400 fixture-units require a 4-inch stack.

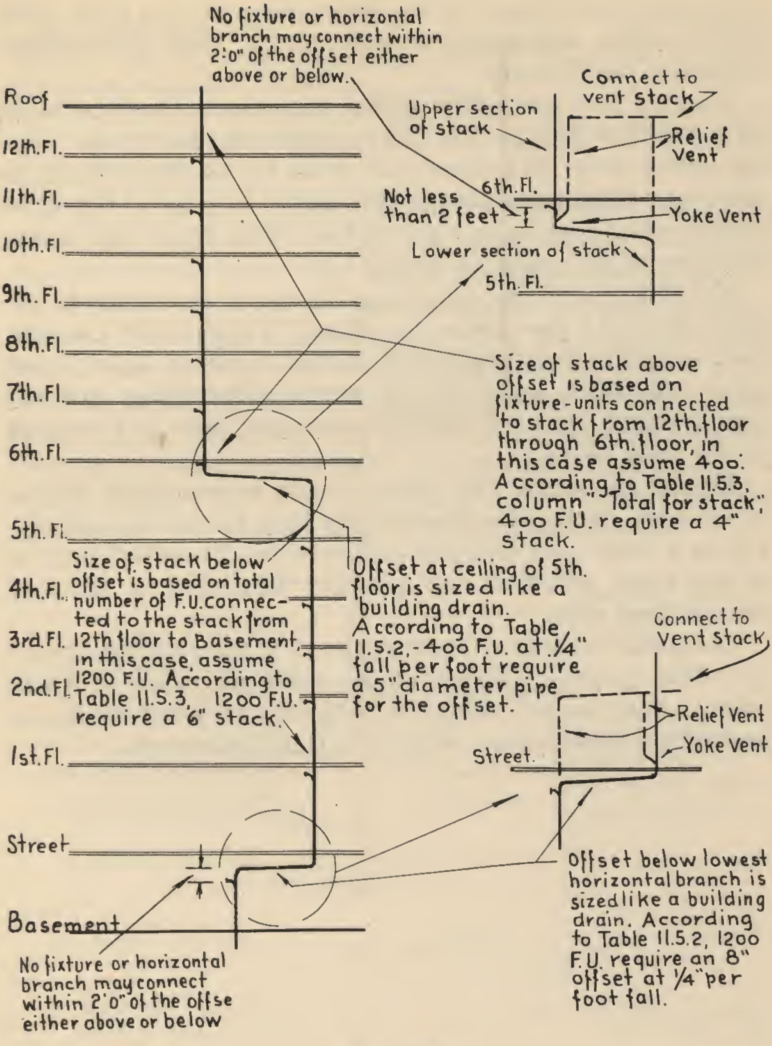


Fig. 107

Step 3: Size the offset on the fifth floor. An offset is sized like a building drain. According to table 11.5.2, column "¼-inch fall per foot," 400 fixture-units require a 5-inch offset.

Step 4: Size the lower portion of the stack from the fifth floor down through the street floor. The lower portion of the stack must be large enough to serve all the fixture-units

connected to it, from the top floor down, in this case, 1200 fixture-units. According to table 11.5.3, 1200 fixture-units require a 6-inch stack.

Step 5: Size the offset below the street floor the same as a building drain. The lower offset also has to be large enough to serve all fixture-units from the top floor down, in this case, 1200 fixture-units. According to table 11.5.2, 1200 fixture-units require an 8-inch offset. This 8-inch line is run full size to the building drain.

The fixtures on the sixth floor should be connected to the stack at least 2 feet above the offset. If this is not possible, then connect them separately to the stack at least 2 feet below the offset, and if this is not possible either, run the fixture drain down to the fifth or fourth floor and connect to the stack there.

The offset on the fifth floor should be provided with a relief vent. Sizing the offset larger than the stack, and providing a relief vent will prevent pressures from building up at the point of offset and possibly siphoning or blowing nearby trap seals.

The critical points of a soil stack are at the base and where an offset occurs. Provide ample relieving vents at these points. Each branch should be properly sized and vented to prevent an unbalanced condition within the branch.

12.4 Vent terminals.

12.4.1 *Roof extension*—Extensions of vent pipes through a roof shall be terminated at least 6 inches above it.

12.4.2 *Roof garden*—Where a roof is to be used for any purpose other than weather protection, the vent extensions shall be run at least 5 feet above the roof.

Note: Fig. 108 illustrates a vent terminal extension where the roof is to be used as a sundeck, roof garden, or laundry drying area. The top of the vent terminal should be extended 6½ feet so that it is above the height of a person. Flooring or decks placed over the roof should be considered in measuring height. However, when the roof is not intended to serve other than structural purposes, there is no need of extending a vent terminal higher than 6 inches. Numerous experiments have proved that a vent terminal which extends only 2 or 3 inches above the roof is less apt to develop frost closure than a higher vent terminal.

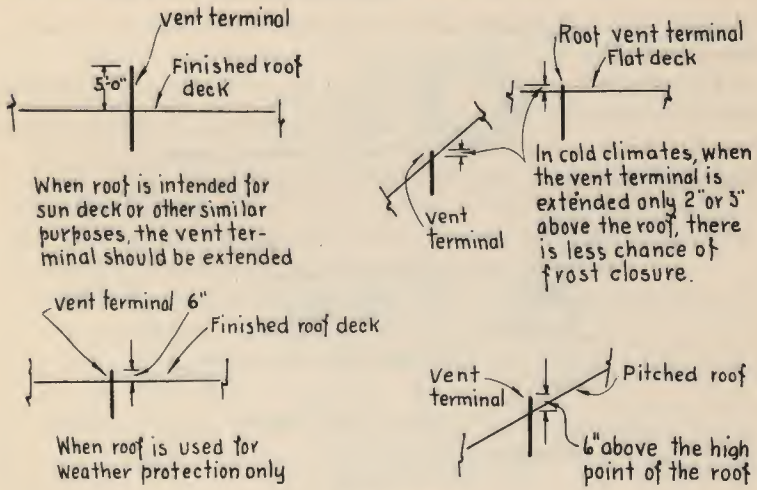


Fig. 108

12.4.3 *Flashings*—Each vent terminal shall be made watertight with the roof by proper flashing.

12.4.4 *Flag poling*—Vent terminals shall not be used for the purpose of flag poling, TV aerials, or similar purposes, except when the piping has been anchored to the construction and approved as safe by the administrative authority.

NOTE: Fig. 109 illustrates some of the various types of flashings for stack vent terminals, as follows:

Sketch (a) shows a flashing on a pitched roof. If the flashing is so constructed that air circulation from the attic space reaches it, frost closure will be lessened during severe cold weather. A piece of mesh screen under the roof prevents vermin from entering the house from the roof during warm weather.

Sketch (b) shows a commonly used flashing adjustable

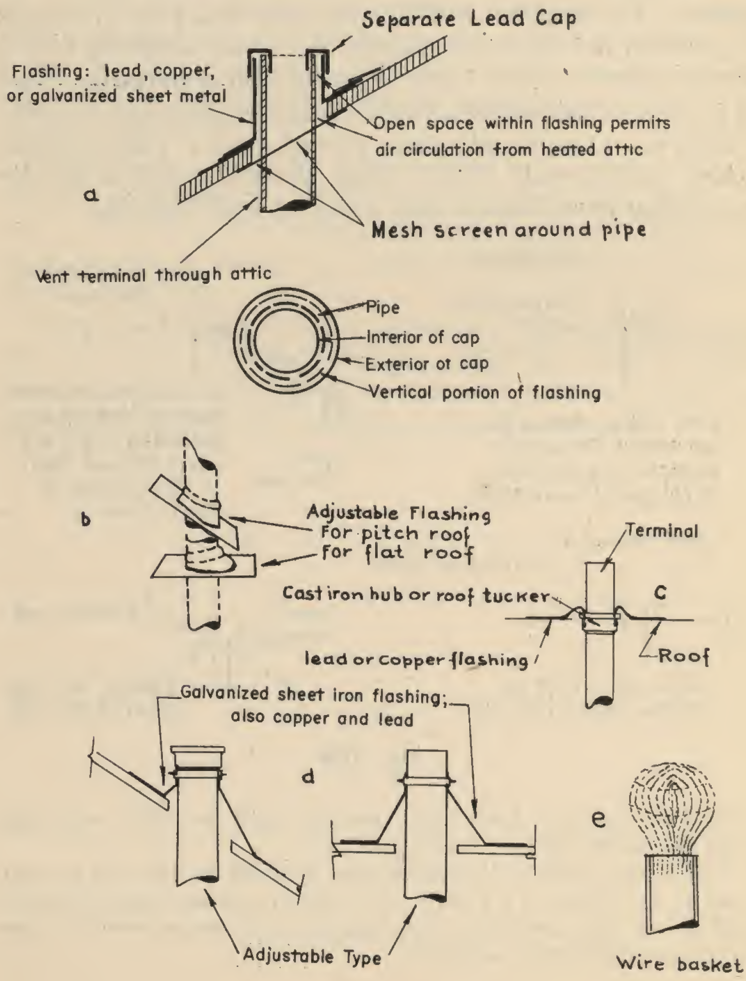


Fig. 109

from horizontal to 45 degrees. It usually is made from 24-gauge galvanized iron, or 14-ounce cold-rolled copper, or 3-pound sheet lead.

Sketch (c) illustrates another method of flashing which brings the hub of cast-iron soil pipe in line with the roof. A copper or lead flashing is calked between the hub and the terminal extension. Prefabricated roof flashings using the same principle are available.

Sketch (d)—This flashing is manufactured of sheet iron, copper or lead. It is made tight around the vent terminal by means of a clamp. It is less substantial than some other types.

Sketch (e)—In a wooded area it is sometimes desirable to provide a wire basket at top of the vent terminal to prevent leaves from falling into and clogging the vent pipe. The basket will also prevent birds from nesting inside a vent terminal.

12.4.5 *Location of vent terminal*—No vent terminal from a drainage system shall be directly beneath any door, window, or other ventilating opening of the building or of an adjacent building nor shall any such vent terminal be within 10 feet horizontally of such an opening unless it is at least 2 feet above the top of such opening.

NOTE: Fig. 110 illustrates the location of a vent terminal when placed near a door or window. The terminal should be extended at least 2 feet above the top of the door or window so as to prevent odors from entering the building.

Other sketches show examples of a vent terminal located near an adjoining building. Where there is a window or door within 10 feet, the vent terminal should be extended at least 2 feet above the opening. Where there is an air inlet, the vent terminal should be extended at least 2 feet above the air inlet to prevent the foul odor from the vent from being drawn into the building.

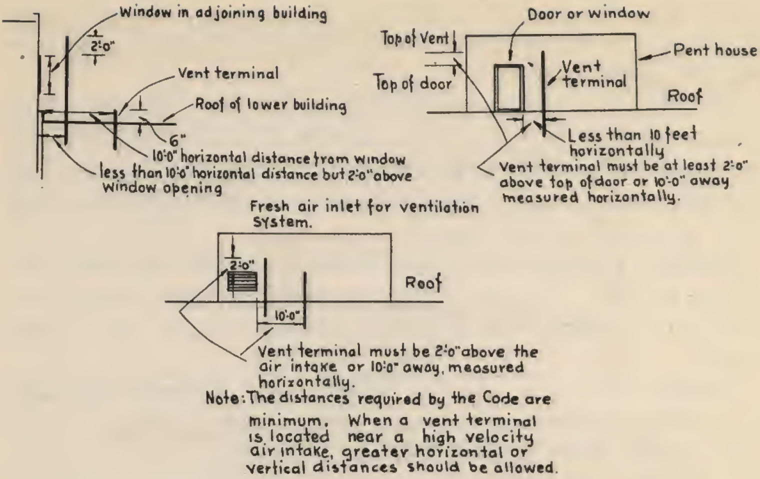


Fig. 110

12.7 Bars and soda-fountain sinks.

12.7.1 *Bar and soda fountain-sink traps*—Traps serving sinks which are part of the equipment of bars, soda fountains, and counters need not be vented when the location and construction of such bars, soda fountains, and counters are such as to make it impossible so to do. When such conditions exist, such sinks shall discharge into a floor sink or hopper which is properly trapped and vented.

12.8 Fixtures back-to-back.

12.8.1 *Distance*—Two fixtures set back-to-back, within the distance allowed between a trap and its vent, may be served with one continuous soil or waste-vent pipe, provided that each fixture wastes separately into an approved double fitting having inlet openings at the same level. [See paragraph 12.10.2.]

Note: Paragraph 12.8.1 states "fixtures set back-to-back." However, fixtures set side-by-side are included under this paragraph. (See Fig. 119.)

12.9 Fixture vents.

12.9.1 *Distance of trap from vent*—Each fixture trap shall have a protecting vent so located that the slope and the developed length in the fixture drain from the trap weir to the vent fitting are within the requirements set forth in table 12.9.3.

Note: Fig 111 illustrates how to measure the developed length of a drain from the weir of a fixture trap to a vent opening, including an offset. The developed length is measured along the length of the pipe and fittings, following the

turns. This developed length should conform to the developed lengths prescribed by table 12.9.3, column "Distance trap to vent."

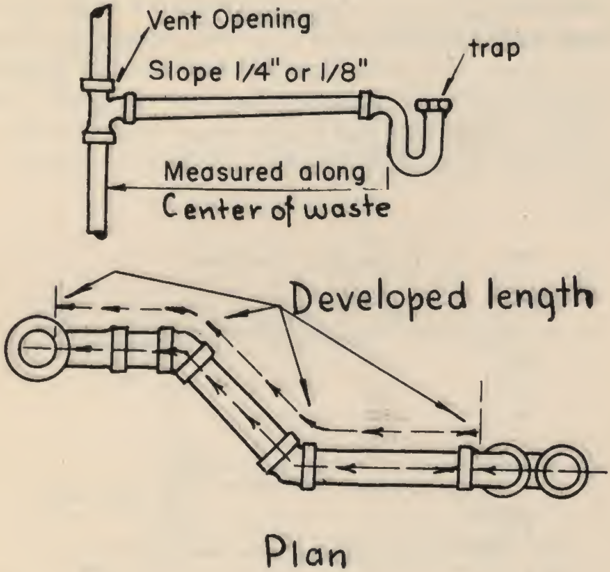


Fig. 111

12.9.2 *Trap seal protection*—The plumbing system shall be provided with a system of vent piping which will permit the admission or emission of air so that under normal and intended use the seal of any fixture trap shall not be subjected to a pressure differential of more than 1 inch of water.

TABLE 12.9.3—DISTANCE OF FIXTURE TRAP FROM VENT

Size of fixture drain (inches)	*Distance trap to vent*	
	Feet	*Inches*
1¼	2	6
1½	3	6
2	5	0
3	6	0
4	10	0

12.9.4 *Trap dip*—The vent pipe opening from a soil or waste pipe, except for water closets and similar fixtures, shall not be below the weir of the trap.

NOTE: Fig. 112 illustrates the requirements of paragraph 12.9.4. A fixture drain which slopes more than 1 pipe diameter between the vent opening and the trap weir has a greater tendency to self-siphon the trap seal than a fixture drain installed at a slope of not more than 1 pipe diameter.

A fixture trap installed on a 1¼-inch diameter drain and within 12 inches of a vent opening but sloping more than 1 pipe diameter is apt to self-siphon the trap seal quicker than a fixture trap installed 4 feet away from a vent opening, but sloping ¼-inch per foot or slightly less than a pipe diameter.

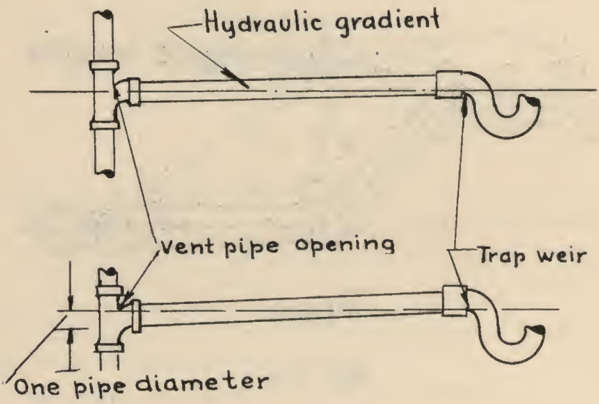


Fig. 112

Fig. 113 illustrates the permitted distance from trap to vent according to measurements given in table 12.9.3. It is good practice to limit the slope to ¼- or ⅛-inch per foot. This will give a lower flow rate and reduce the possibility of self-siphoning of the trap.

The distances given in table 12.9.3 will provide a safe installation. The extent to which the above unvented drains are safe may be compared with the findings of tests conducted at the National Bureau of Standards.

Fig. 114 illustrates the safe distance from trap center to vent opening when a sanitary tee is used at both ¼- and ½-inch slopes. The distance shown in Figs. 114 and 115 were recommended previously in the Uniform Plumbing Code (see Bibliography) and are shown here for comparison.

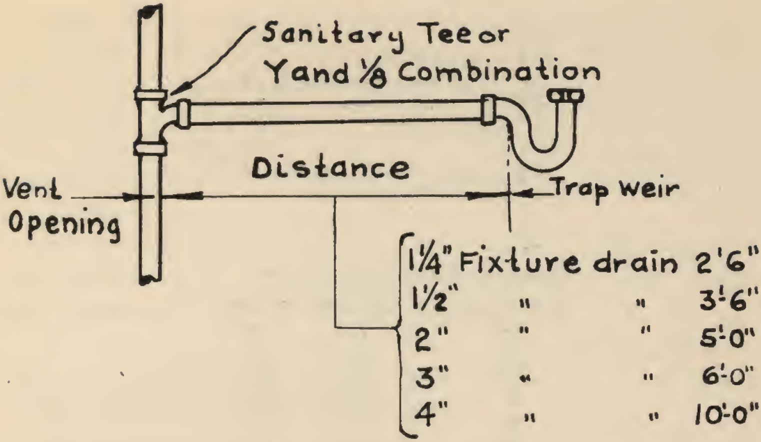
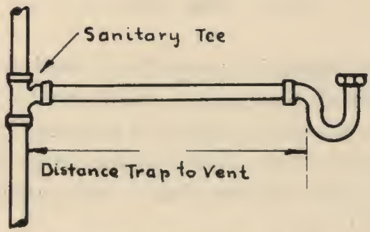


Fig. 113

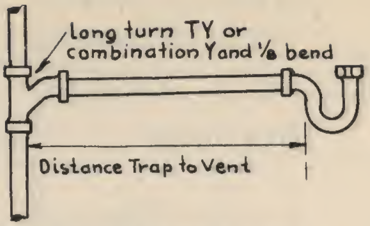


Size of fixture Drain (inches)	Length in feet ¼" Slope	½" Slope
1¼	4'-0"	2'-6"
1½	4'-6"	3'-0"
2	5'-0"	4'-0"
3	6'-0"	6'-0"
4	8'-0"	8'-0"

Fig. 114

Fig. 115 illustrates the safe distance from trap weir to vent opening when using a long turn TY or combination wye and ⅛ bend at ¼-inch and ½-inch slopes.

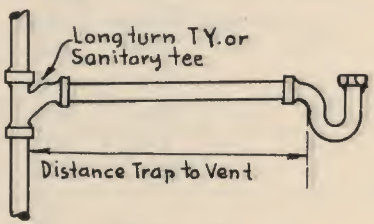
NOTE: It should be noted from the study of Figs. 115 and 116 that when a long turn fitting is used, the distance from trap to vent is reduced. This is due to the fact that a long turn fitting increases the flow velocity in the fixture drain and therefore is more apt to self-siphonage.



Size of fixture Drain (inches)	Length in feet	
	¼" Slope	½" Slope
1¼	1'-6"	1'-0"
1½	4'-0"	2'-0"
2	4'-6"	4'-0"
3	6'-0"	6'-0"
4	8'-0"	8'-0"

Fig. 115

Fig. 116 illustrates the results of tests conducted at the National Bureau of Standards. Note that a requirement for all tests is that a 1-inch trap seal remain in the trap at the completion of each test. During the tests, the total flow of water through the various drains was greater than under ordinary conditions.



Size of fixture Drain (inches)	Length in feet			
	Long TY		San. Tee.	
	¼"	½"	¼"	½
1¼	4'-0"	3'-0"	5'-6"	3'-0
1½	6'-0"	3'-0"	7'-0"	3'-6"
2	8'-0"	4'-0"	11'-0"	5'-6"
3	12'-0	6'-0"	12'-0"	6'-0"
4	16'-0"	8'-0"	16'-0"	8'-0"

Fig. 116

NOTE: When additional research has been completed, providing more data both on siphonage and on self-siphonage due to the effects of corrosion within the fixture drain, it may be possible to recommend distances from traps to vents which were found safe during the tests. The incidence of trap siphonage is considerably lessened when the following are used:

(a) A refill in a direct flush valve, and a refill tube in a water closet tank. A refill restores the trap seal after it has been siphoned during the flushing operation.

(b) Flat-bottom fixtures of at least 120-square-inch area. After flat-bottom fixtures have drained, enough water is left on the bottom to restore the trap seal.

Self-siphonage of a fixture trap is caused by many conditions, some of which are:

(a) Improper length of unvented fixture branch.

(b) Type of trap and amount of water in the seal, particularly depth.

(c) Excessive rate of discharge through the trap.

(d) Radius of trap in this respect; a cast trap, containing a shorter radius than a tube-drawn trap, will not siphon as readily because it offers greater resistance to pressure.

(e) Too small diameter of drain from trap outlet to vent connection.

(f) Diameter of P. O. plug and tailpiece.

(g) Slope of drain pipe from trap to vent. (See Bibliography.)

12.9.5 *Crown vent*—No back vent shall be installed within two pipe diameters of the trap weir. [See Fig. 31.]

12.10 COMMON VENT.

12.10.1 *Individual vent*—An individual vent, installed vertically, may be used as a common vent for two-fixture traps when both fixture drains connect with a vertical drain at the same level.

Fig. 117 illustrates an individual vent. Other names are "back vent" and "continuous vent."

12.10.2 *Common vent*—A common vent may be used for two fixtures set on the same floor level but connecting at different levels in the stack, provided the vertical drain is one pipe diameter larger than the upper fixture drain but in no case smaller than the lower fixture drain, whichever is the larger, and that both drains conform to table 12.9.3.

NOTE: Fig. 118 illustrates a common vent for a plumbing

fixture. It is a vent serving more than one fixture trap.

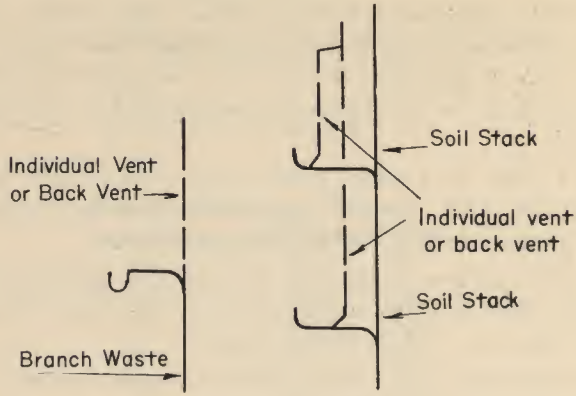


Fig. 117

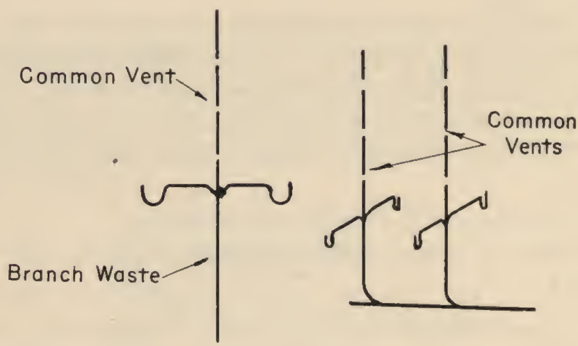


Fig. 118

Fig. 119 illustrates other methods of installing a common vent. Two fixtures may be installed back-to-back with a common vent or side-by-side with a common vent.

Fig. 120 illustrates another method of installing a common vent for two bathtubs, back-to-back. Sketch (a) shows the common vent taken on the downflow of the twin connections for the two bathtubs. Sketch (b) shows the common vent at the end of the run. In sketch (c), note that the common vent installed on the downflow will remain clear, but

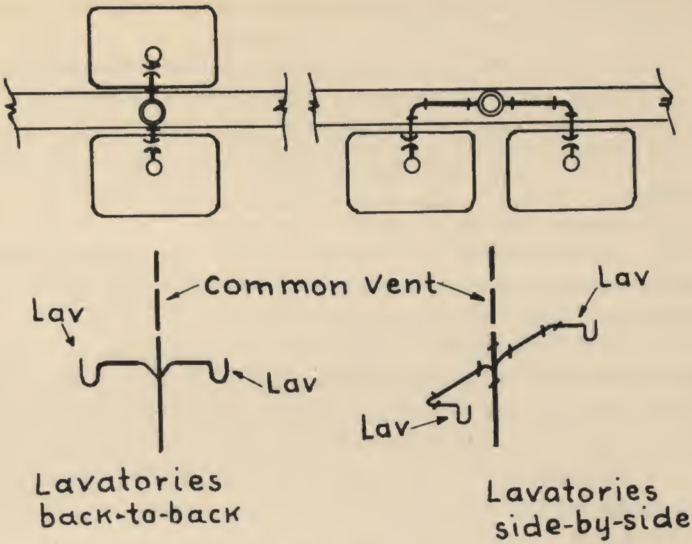


Fig. 119

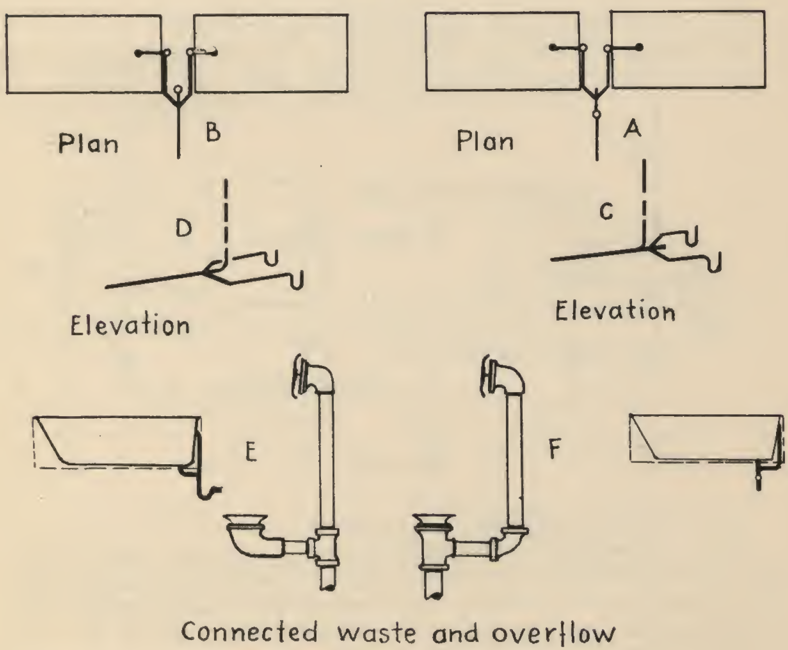


Fig. 120

that in sketch (d) it will eventually become clogged up by the backwash from the bathtub discharges.

Sketch (e) shows the most common method of installing a bath trap on a connected waste and overflow. Sketch (e) requires a special type of connected waste and overflow which is used when it is necessary to clear some structural interference.

Fig. 121 illustrates the requirement of paragraph 12.10.2, where the fixtures are connected at two different levels, and where the upper fixture drain is of the same diameter as the lower fixture drain. Under these conditions the waste pipe connecting both branches must be increased one pipe size. If the upper drain is a lavatory with a 1¼-inch waste, the vertical waste pipe may be 1½ inches in diameter. The fixture which has the lesser flow should be connected at the top to prevent the discharge from the upper fixture siphoning the trap seal of the lower fixture, as the discharge passes the lower opening.

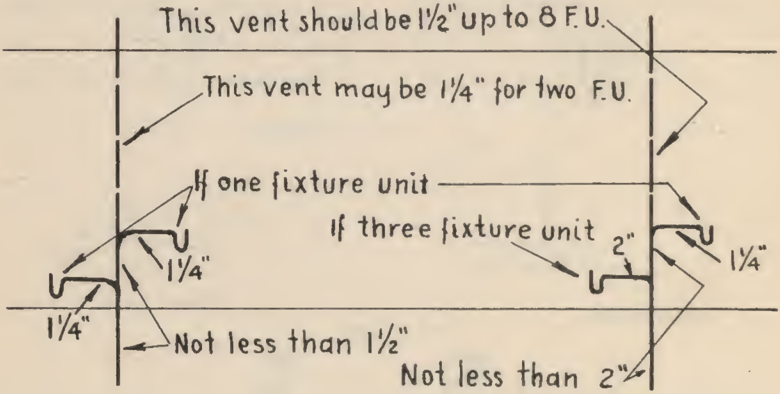


Fig. 121

12.11 VENTS FOR FIXTURE TRAP BELOW TRAP DIP.

12.11.1 *Hydraulic gradient*—Fixture drains shall be vented within the hydraulic gradient between the trap outlet and vent connection, but in no case shall the unvented drain exceed the distance provided for in table 12.9.3. [See Fig. 112.]

12.11.2 *Different levels*—If any stack has fixtures entering at different levels, the fixtures other than the fixture entering at the highest

level shall be vented, except as may be permitted in other sections of this chapter.

12.12 Wet venting.

12.12.1 *Single bathroom groups* — A single bathroom group of fixtures may be installed with the drain from a back-vented lavatory, kitchen sink, or combination fixture serving as a wet vent for a bathtub or shower stall and for the water closet, provided:

(a) Not more than one fixture unit is drained into a 1½-inch diameter wet vent, or not more than 4 fixture units drain into a 2-inch diameter wet vent.

(b) The horizontal branch connects to the stack at the same level as the water closet drain or below the water closet drain when installed on the top floor. It may also connect to the water closet bend.

NOTE: Fig. 122 shows an arrangement of wet venting a group of fixtures which has been found to be safe as a result of many years of practice and has been proved safe by tests conducted at various laboratories. (See Bibliography.)

A bathroom group, total of 7 fixture-units, as follows: a flush tank water closet rated 4 fixture-units; a lavatory, 1 fixture-unit, and a bathtub, 2 fixture-units. However, as a group, the rating is computed only as 6 fixture-units because of the improbability of all the fixtures being used at the same time. The lavatory waste may be used as a vent for the bathtub. The wet vent for the fixtures may be 1½ inches in diameter.

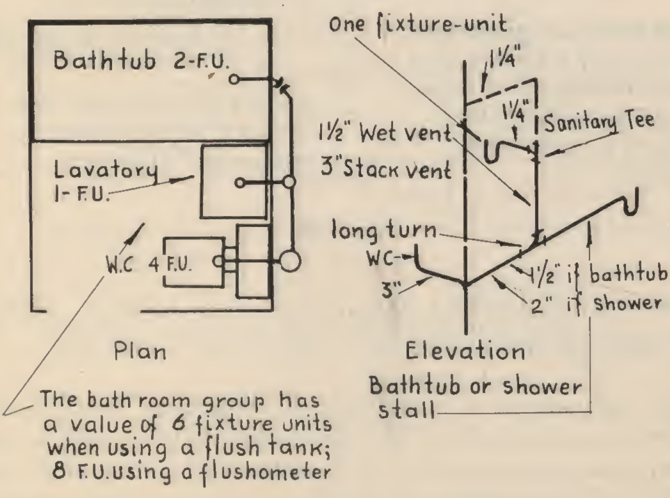


Fig. 122

Fig. 123 shows a bathroom similar to Fig. 122, but with slight variations to meet other generally accepted methods of installation. The bathtub is provided with a drum trap and cleanout at floor, and the lavatory has a higher rating valued at 2 fixture-units. This group of fixtures is still rated 6 fixture-units on the basis of the over-all load that is computed for the stack. However, the lavatory branch is now computed as 2 fixture-units. As paragraph 12.12.1(a) permits only 1 fixture-unit on a 1½-inch diameter wet vent, this wet vent must now be increased to 2 inches as shown.

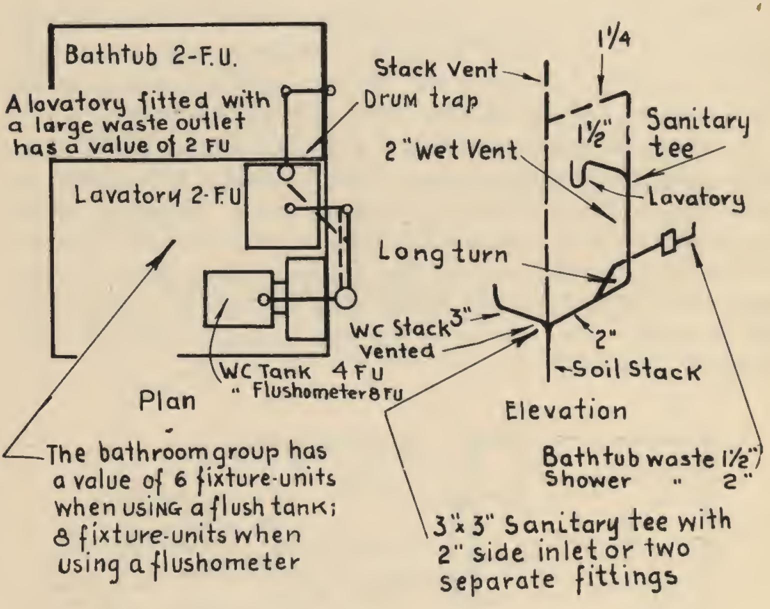


Fig. 123

Fig. 124 illustrates a bathroom similar to Figs. 122 and 123 plus a kitchen sink back to back of the bathroom.

Fig. 125 shows a grouping of bathroom fixtures and kitchen sink similar to Fig. 124, except that the sink is connected separately into the horizontal drain. Should a dishwasher or food-waste grinder be added at a later date, the separate sink waste would prove more satisfactory.

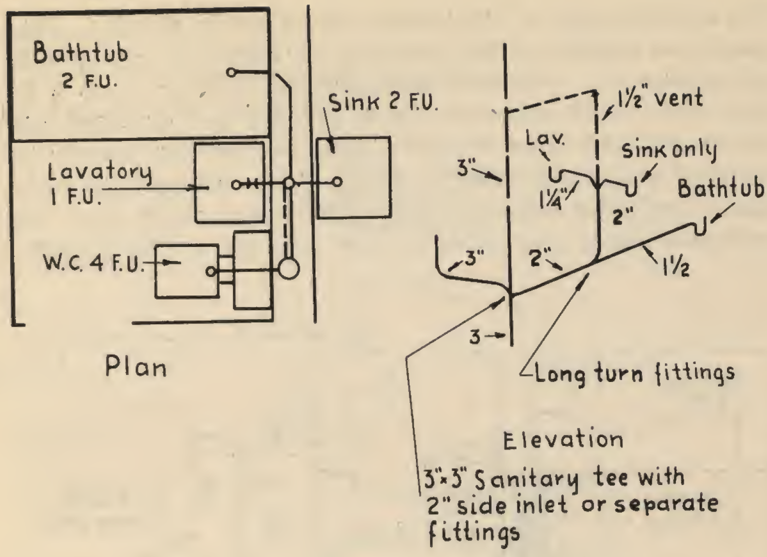


Fig. 124

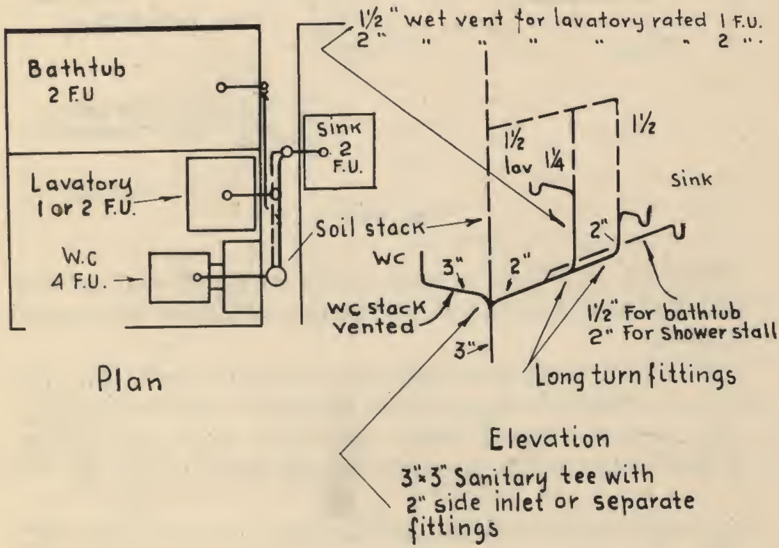


Fig. 125

Fig. 126 illustrates an efficient roughing for the bathroom fixtures and for a kitchen sink adjoining the bathroom.

The kitchen sink is fitted with a food-waste grinder. The maximum number of fixture-units permitted by paragraph 12.12.1(a) is 4. When a 2-fixture-unit lavatory and a 3-fixture-unit sink with food-waste grinder are installed, the 2-inch wet vent is too small. Therefore, the sink should be roughed separately onto the 3-inch stack. Being separately back-vented and connected below the water closet inlet, the sink vent would also act as a relief vent for all the fixtures.

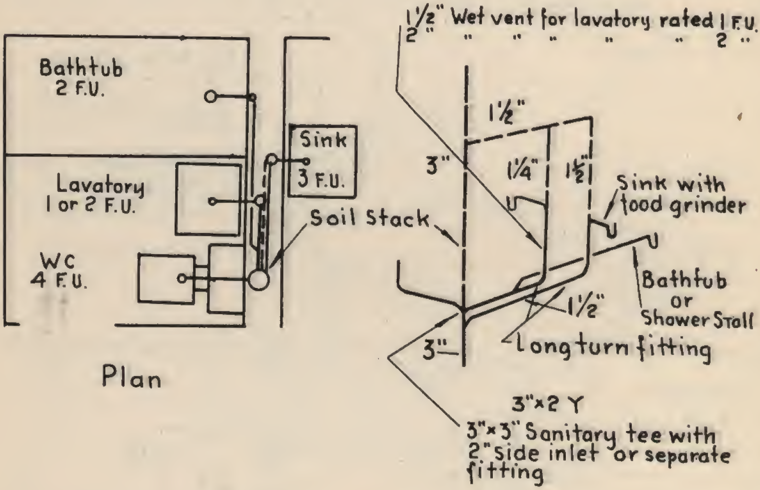


Fig. 126

Variations in fixture arrangements on a wet vent system within the requirements of paragraph 12.12 are illustrated as follows:

Fig. 127 shows an arrangement commonly used. The wet vent may connect at the soil stack through a side inlet fitting, or to a separate fitting below the water closet connection, or it may connect into the water closet bend as shown.

Fig. 128 is similar to the arrangement shown in Fig. 127 except for location of fixtures.

Fig. 129 illustrates another piping arrangement for a group of bathroom fixtures. It permits installation of the bathtub away from a window. The bathtub is a 5-foot left-

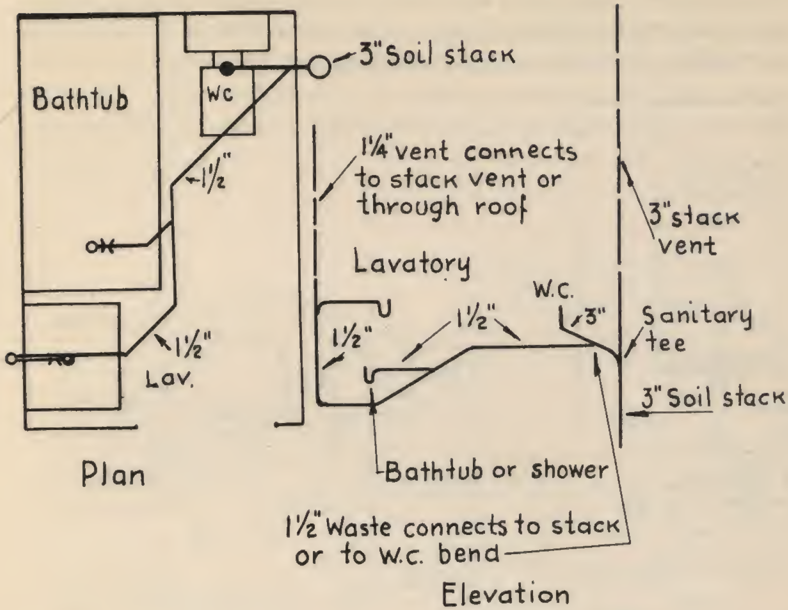


Fig. 127

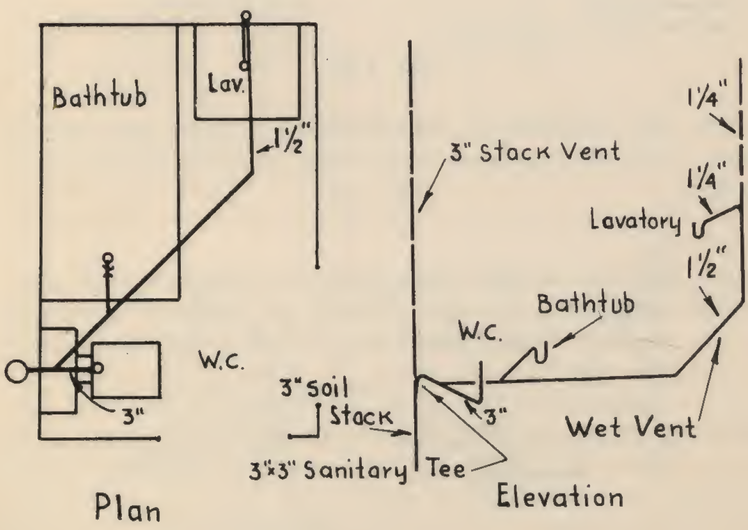


Fig. 128

hand recess type. The free end of the bathtub can be built-up as shown in section "AA." The shower over the bathtub is readily controlled through a transfer valve.

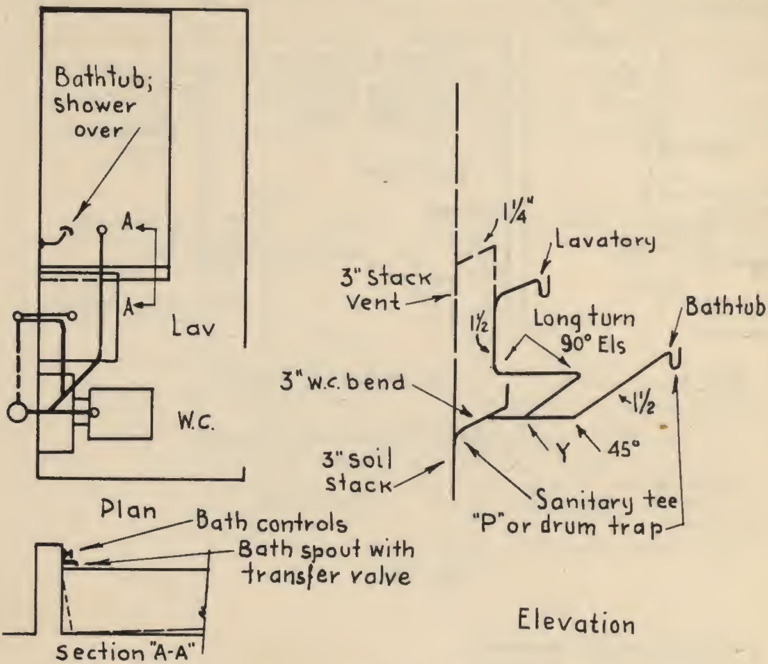


Fig. 129

Fig. 130 illustrates a minimum-space toilet and shower room. This arrangement lends itself to many variations in design.

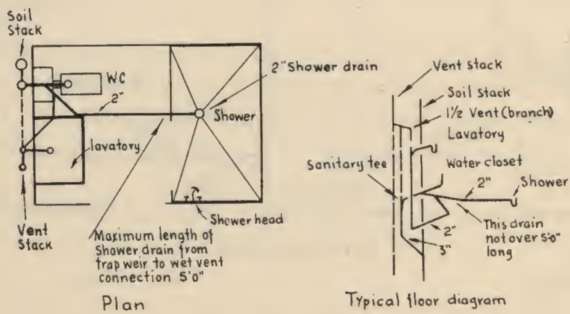


Fig. 130

Fig. 131 is a modification of fixture arrangement shown in Fig. 130. It is suitable in a hotel, for instance, or wherever a shower-bathroom is installed between two bedrooms. A lavatory could be installed in each bedroom, in which case the size of the shower-bathroom could be reduced, as shown in insert (a).

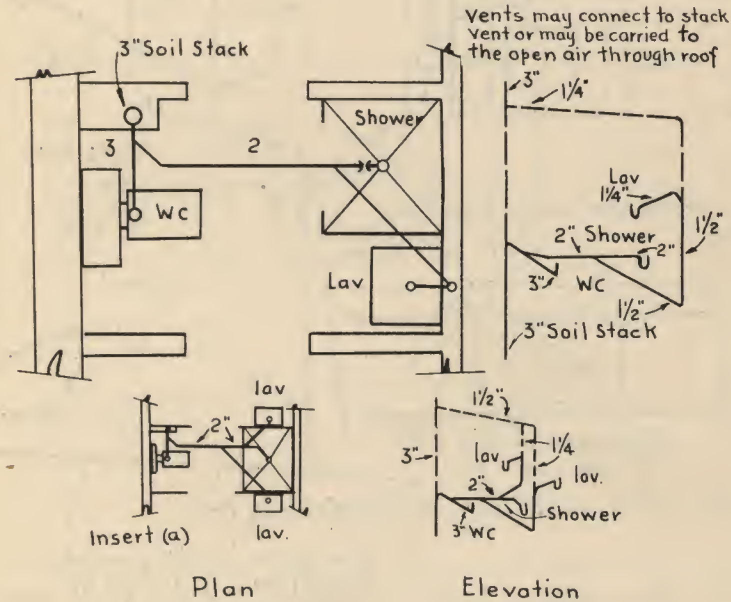


Fig. 131

Fig. 132 illustrates wet venting of fixtures in a two-story one-family dwelling. A kitchen sink is on the first floor, located almost directly below the bathroom.

In Fig. 133, the bathroom is on the second floor. A 2-compartment sink with food-waste grinder, and a powder room near the kitchen are on the first floor.

To size the building drain, refer to table 11.5.2; to size the fixture branches and stack, refer to table 11.5.3, second and third columns; and to size the venting system, refer to table 12.21.5.

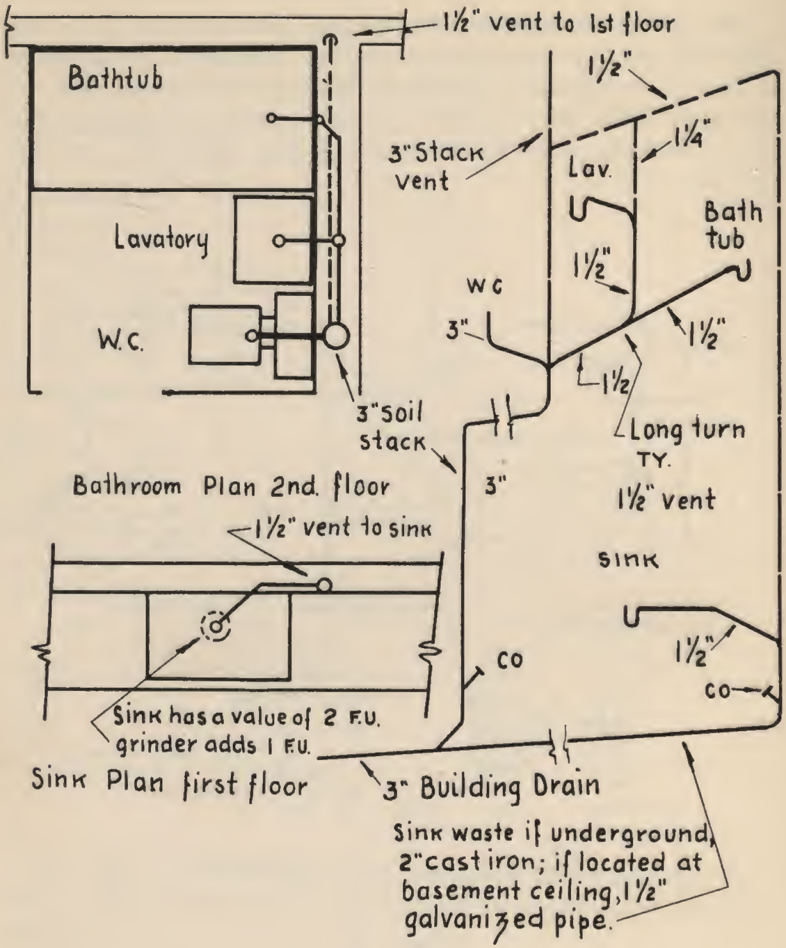


Fig. 132

Fig. 134 is an arrangement of fixtures similar to Fig. 132, plus a laundry tray and a water closet in the basement. The water closet, if properly located, may be wet vented through the laundry tray roughing. When connecting basement fixtures to the building drain, the connection should be made at least 10 feet downflow from the base of the stack. This distance is sufficient to permit the pressures generally developed at the base of a stack to become balanced, therefore causing less disturbance to the trap seals of the fixtures located near the base of the stack.

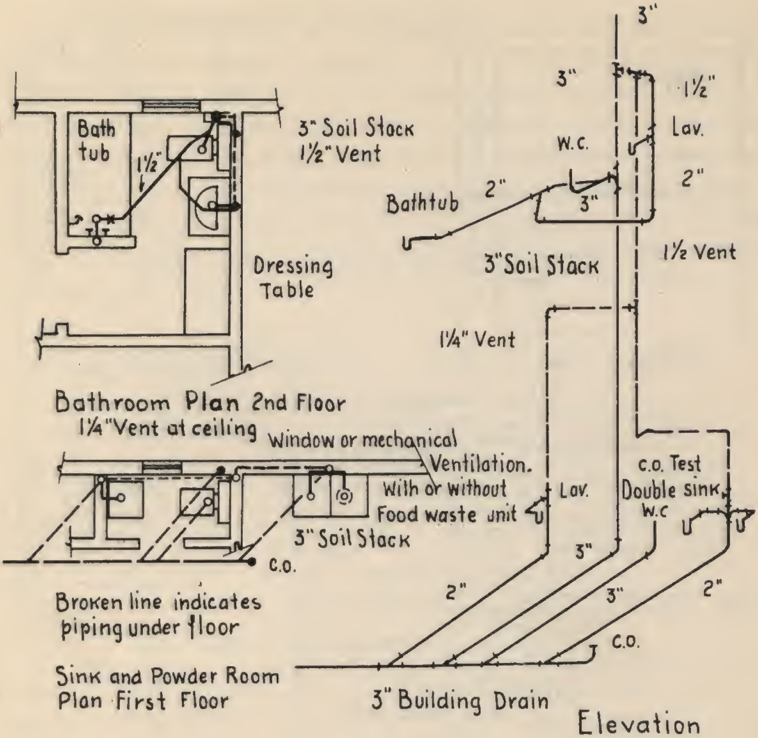


Fig. 133

12.12.2 *Double bath*—Bathroom groups back-to-back on top floor, consisting of two lavatories and two bathtubs or shower stalls, may be installed on the same horizontal branch with a common vent for the lavatories and with no back vent for the bathtubs or shower stalls and for the water closets, provided the wet vent is 2 inches in diameter, and the length of the fixture drain conforms to table 12.9.3.

NOTE: This arrangement can be used if both bathrooms are in one house or under one ownership. In row houses where separate owners occupy each building, a back-to-back combined roughing is not permissible. Each house must be provided with separate roughing in its entirety.

Fig. 135, sketch (a), shows piping underground when a crawl space or basement is available. Sketch (b) shows the piping underground when the elevation of the sewer is such as to require the building drain to be installed as high as possible. Sketch (a) is also suitable for top floor installation.

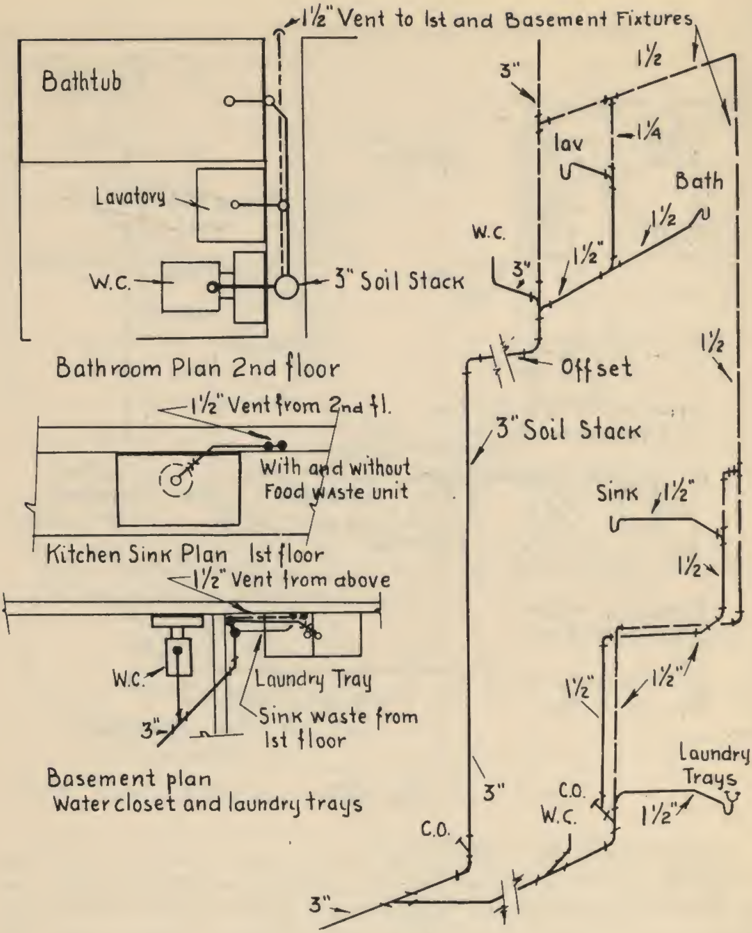


Fig. 134

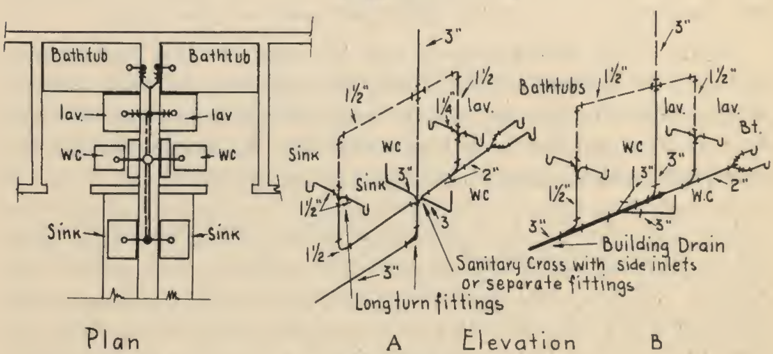


Fig. 135

Fig. 136 illustrates a wet-vented double bathroom with the bathtubs located at opposite sides of the bathroom wall. Sketch (a) is a diagram of the piping when a crawl space or basement is included. Sketch (b) shows when a shallow sewer must be installed. Placing the vent between the two water closet connections will serve the double purpose of keeping the base of the vent clear of stoppages, and of providing balanced air pressure between the two water closet connections.

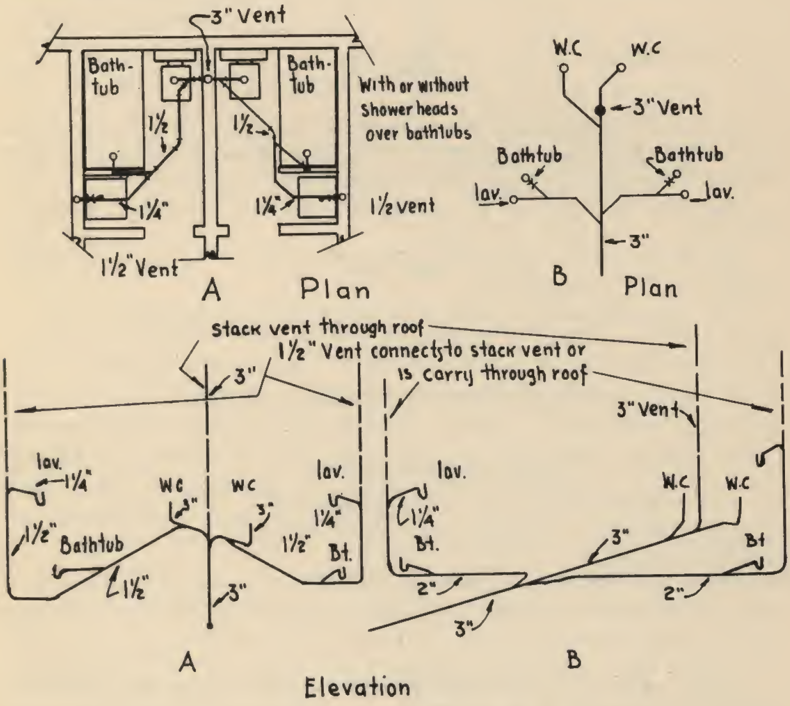


Fig. 136

Fig. 137 illustrates a condition which should be watched carefully when roughing a set of fixtures, particularly where wet-vented fixtures are installed. The smaller flow-rated fixture should not be connected on the downflow of a large flow-rated fixture. A shower or bathtub should be connected ahead of the water closet in order to safeguard the smaller-rated fixture. This arrangement is suitable for a bathroom in the basement.

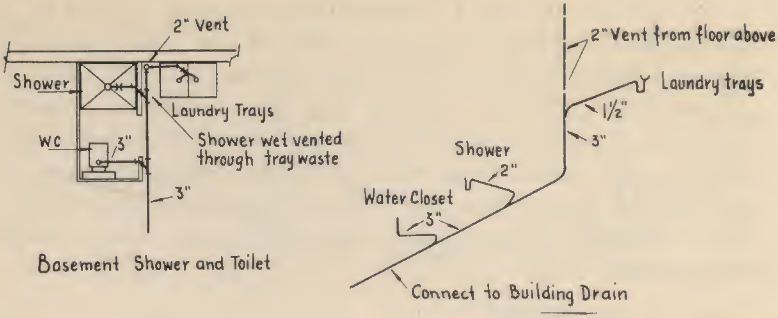


Fig. 137

12.12.3 *Multi-story bathroom groups*—On the lower floors of a multi-story building, the waste pipe from 1 or 2 lavatories may be used as a wet vent for 1 or 2 bathtubs or showers provided that:

(a) The wet vent and its extension to the vent stack is 2 inches in diameter.

(b) Each water closet below the top floor is individually back-vented.

(c) The vent stack is sized as given in table 12.12.3(c).

TABLE 12.12.3 (*c*) *Size of vent stacks*

Number of wet-vented fixtures	Diameter of vent stacks (inches)
1 or 2 bathtubs or showers	2
3 to 5 bathtubs or showers	2½
6 to 9 bathtubs or showers	3
10 to 16 bathtubs or showers	4

NOTE: Fig. 138 illustrates wet venting of a fixture or a bathroom group in a multi-story building. Installations of this type have been made in principal cities for many years and have proved safe.

The illustration shows a typical bathroom arrangement of a single bathroom on each floor with the bathtub wet vented through the lavatory. The water closet on the top floor need not be vented, since it already is stack vented. The base of the vent stack should be washed by the lowest lavatory, in which case the vent should connect full size into the soil stack.

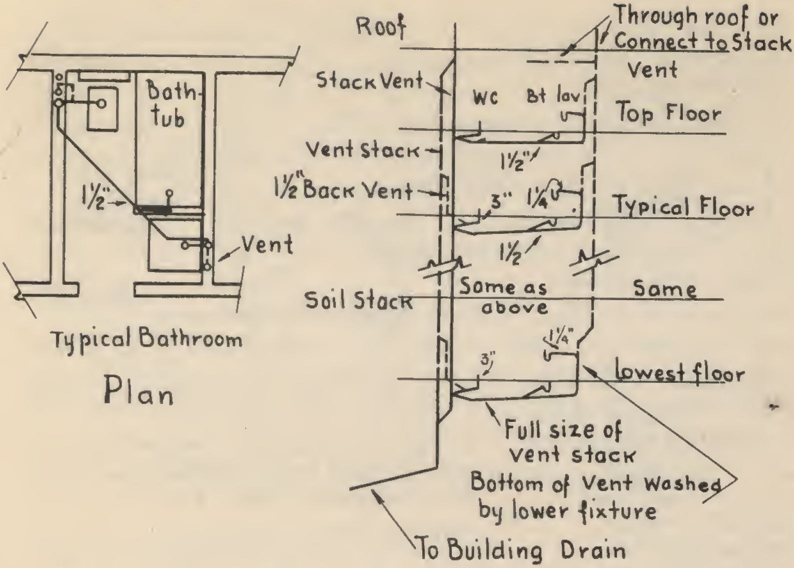


Fig. 138 Elevation

Fig. 139 shows the same bathroom arrangement as Fig. 138, with an installation which probably is more economical and just as efficient. Soil, waste and vent stacks are sized according to tables 11.5.3 and 12.21.5. This arrangement will eliminate expensive framing of the floor construction which the piping arrangement in Fig. 138 will require. The bathtub is wet vented through the lavatory.

12.12.4 *Exception*—In multi-story bathroom groups, wet-vented in accordance with paragraph 12.12.3, the water closets below the top floor need not be individually vented if the 2-inch waste connects directly into the water closet bend at a 45-degree angle to the horizontal portion of the bend in the direction of flow.

NOTE: Fig. 140 illustrates an alternate method of wet venting a single bathroom in which the bathtub and water closet are wet vented through the lavatory by using pipe one size larger. Installations similar to those shown here have been used in many cities for more than 20 years.

Fig. 141 illustrates various ways of roughing double bathrooms in a multi-story building. Construction conditions often cause problems which require special roughing layouts.

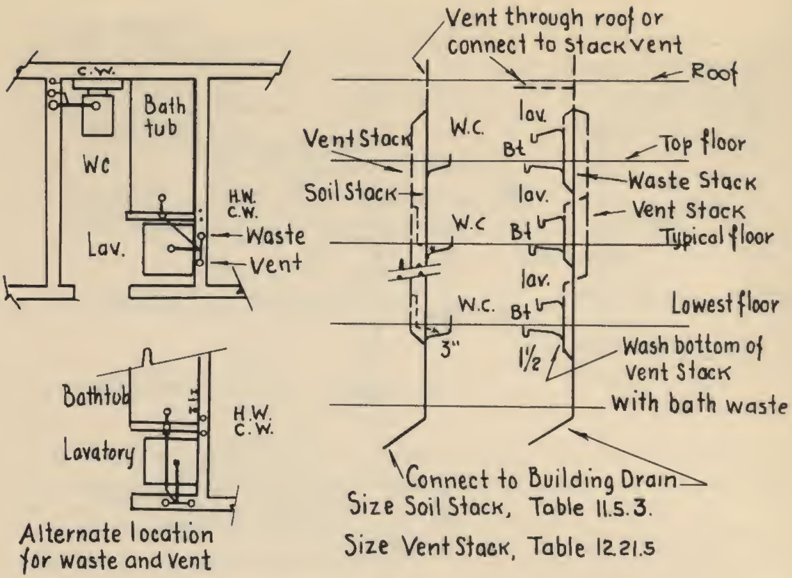


Fig. 139

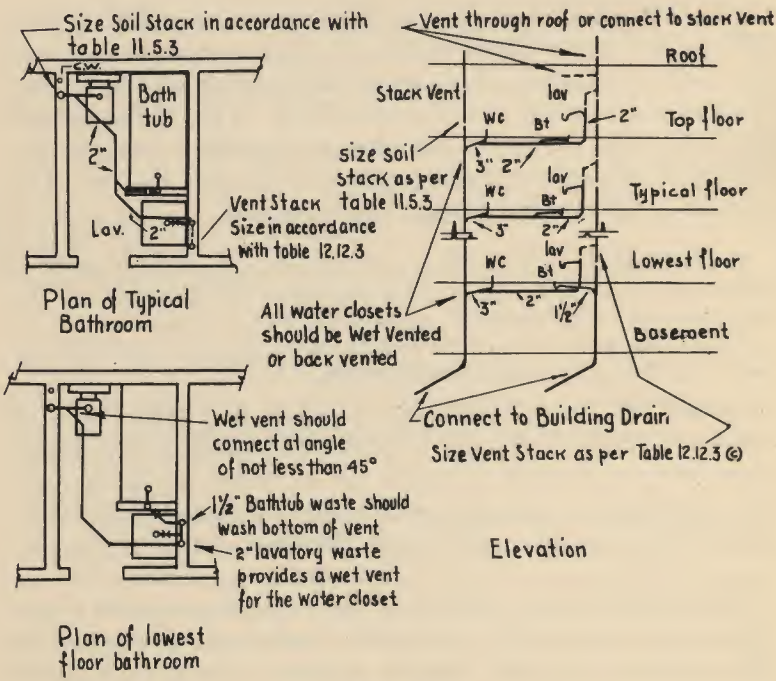


Fig. 140

Sketch (a) is a conventional arrangement of fixtures, and the two bathrooms back-to-back are wet-vented. Some cities require an access door for the bathtub waste. This is not necessary when the joints for the bath waste are sweated together, eliminating slip joint connections as possible leaks.

Sketch (b) is a piping arrangement for two bathrooms back-to-back. The bathtubs are wet wented through the lavatory waste. The water closets, except for the top floor, are individually vented.

Sketch (c) shows a piping design which in some cases might be not only more economical than (a) and (b) but more trouble-free, inasmuch as each bathroom waste pipe is independent. In this case the bathtub and water closet are wet vented through the lavatory. The fixtures from each bathroom connect separately to the water closet bend.

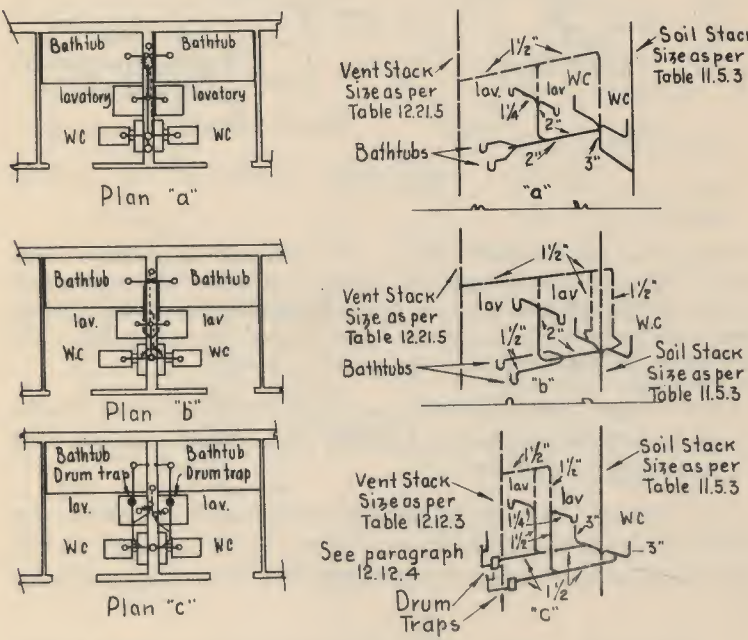


Fig. 141

12.13 Stack venting.

12.13.1 *One-bathroom group*—Except as indicated in paragraph 12.13.2, a group of fixtures consisting of one bathroom group and a

kitchen sink or combination fixture, may be installed without individual fixture vents, in a one-story building or on the top floor of a building, provided each fixture drain connects independently to the stack, and the water closet and bathtub or shower stall drain enter the stack at the same level and in accordance with the requirements of table 12.9.3.

NOTE: Fig. 142 illustrates a single bathroom in a one-story residence. The bathroom fixtures are grouped around the stack so that all individual fixture branches are within the lengths permitted by table 12.9.3. All are vented through the 3-inch soil stack.

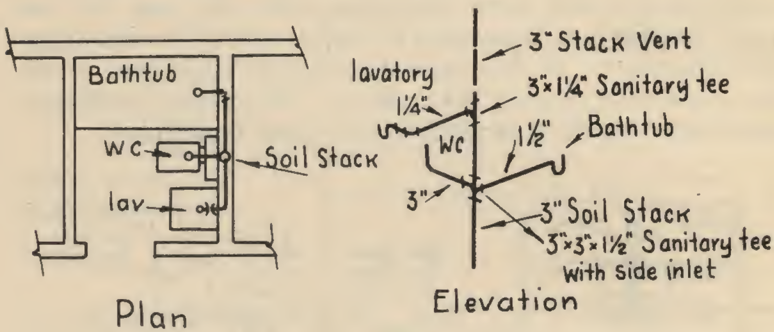


Fig. 142

12.13.2 *Overtaxed sewers*—When a sink or combination fixture connects to the stack-vented bathroom group, and when the street sewer is sufficiently overloaded to cause frequent submersion of the building sewer, a relief vent or back-vented fixture shall be connected to the stack below the stack-vented water closet or bathtub.

NOTE: Fig. 143 illustrates a relief vent below a stack-vented water closet when a kitchen sink is installed as part of the group, as follows:

(a) This is the conventional arrangement in which the discharge from the bathtub or shower stall connects at the same level as the water closet through a side-inlet sanitary tee.

(b) By back venting the sink and carrying waste below the water closet connection, a relief is provided in the event that the building drain elevation is close to the public sewer and the public sewer is already overtaxed. Back venting the sink is also desirable when food-waste grinders or dishwashers are part of the kitchen sink.

(c) Certain localities require that a building drain be installed as high as possible in order to connect with either the sewer or place of disposal, in which case the water closet and bathtub or shower connect to the horizontal or building drain.

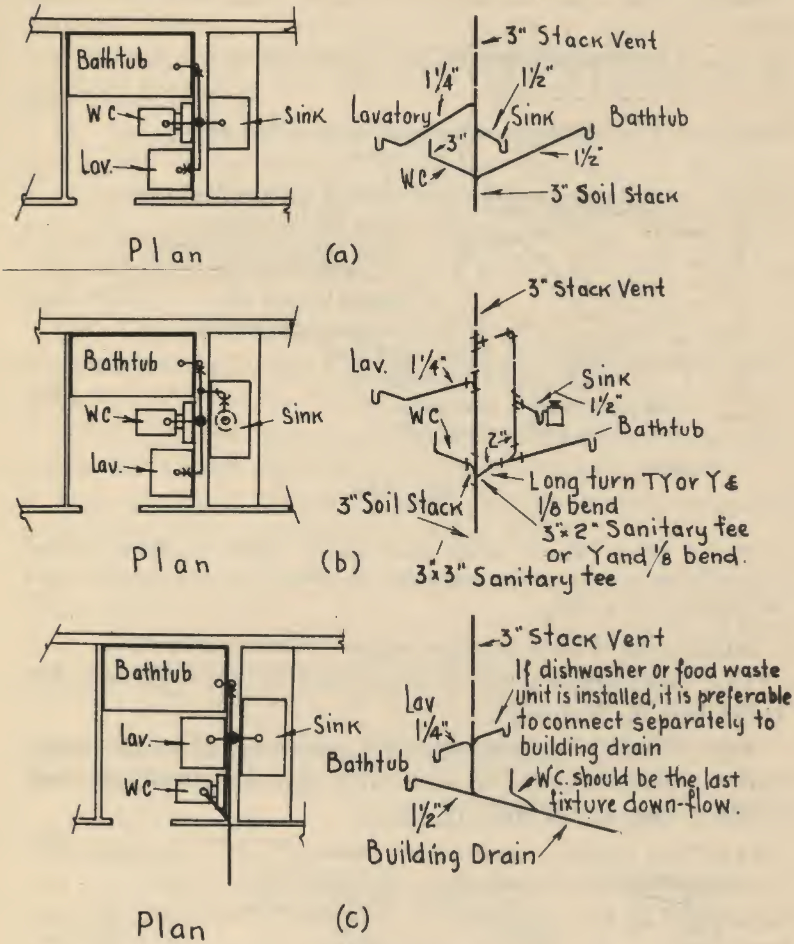


Fig. 143

12.14 Individual fixture reventing.

12.14.1 *Horizontal branches*—One sink and one lavatory, or three lavatories within 8 feet developed length of a main-vented line may be installed on a 2-inch horizontal waste branch without reventing, provided the branch is not less than 2 inches in diameter throughout its length; and provided that the wastes are connected into the side of the

branch, and the branch leads to its stack connection with a slope of not more than ¼-inch per foot.

NOTE: Fig. 144 illustrates the provision of paragraph 12.14.1. It is limited to three lavatories or to one lavatory and one sink.

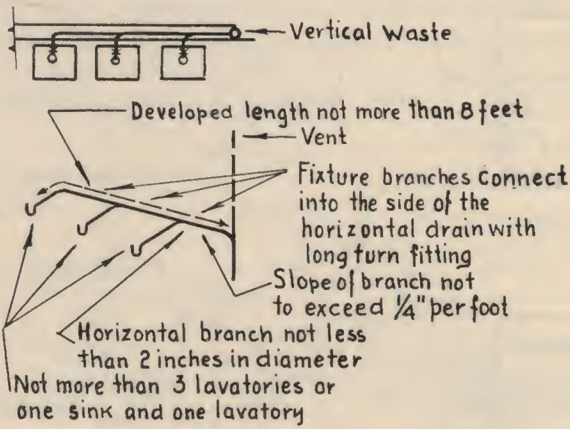


Fig. 144

12.14.2 When fixtures other than water closets discharge downstream from a water closet, each fixture connecting downstream shall be individually vented.

NOTE: Fig. 145 illustrates several such conditions.

(a) The shower must be separately back vented in order to protect its trap seal.

(b) When the shower connects upstream from the water closet connection, the shower trap may be considered wet vented. See paragraph 12.4.3.

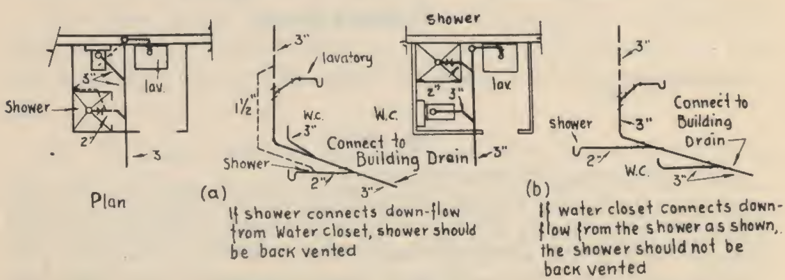


Fig. 145

12.14.3 *Limits of fixture-units above bathtubs and water closets*—A fixture or combination of fixtures whose total discharge rating is not more than 3 fixture-units may discharge into a stack not less than 3 inches in diameter without reventing, provided such fixture connections are made above the connections to the highest water closet, or bathtub TY, the fixture-unit rating of the stack is not otherwise exceeded, and their waste piping is installed as otherwise required in paragraph 12.14.1.

NOTE: Fig. 146 illustrates the requirements described in paragraph 12.14.3.

(a) A bathroom on the 2nd floor connects to the 3-inch soil stack. If the fixtures above the bathroom on the 3rd and 4th floors do not total more than 3 fixture-units, and if they also connect directly into the 3-inch soil stack, they need not be back vented. The sink on the 1st floor must be back vented.

(b) Three lavatories, one on each of three floors, may be connected directly into a 3-inch waste stack without a back vent.

(c) If a water closet is on the 3rd floor and the lavatories are below it, each lavatory must be individually vented.

The developed length of each fixture branch must be within the limits prescribed by table 12.9.3.

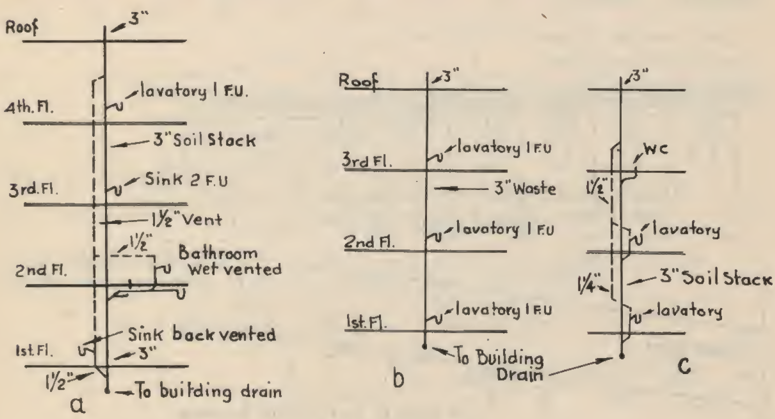


Fig. 146

12.15 CIRCUIT AND LOOP VENTING.

12.15.1 *Battery venting*—A branch soil or waste pipe to which 2 but not more than 8 water closets (except blow-out type), pedestal

urinals, trap standard to floor, shower stalls, or floor drains are connected in battery, shall be vented by a circuit or loop vent which shall take off in front of the last fixture connection. In addition, lower-floor branches serving more than 3 water closets shall be provided with a relief vent taken off in front of the first fixture connection. When lavatories or similar fixtures discharge above such branches, each vertical branch shall be provided with a continuous vent.

NOTE: Figs. 147 and 147a represent a typical loop-vented water closet row installed on the top floor of a building or in a one-story building.

(a) The horizontal branch is installed at back below the water closet. The connections, therefore, are made with long-turn TY's or combination Y and 1/8 bend set flat.

(b) This is the same toilet room except that the horizontal branch is directly under the water closets; therefore, the long-turn TY, or Y and 1/8 bend are installed with the inlet looking up.

The arrangement shown in (a) provides more satisfactory operation because it permits each closet to discharge into the side of the horizontal branch. This generally does not affect air circulation as much as when the water closet discharges through the top of the branch.

Blow-out type water closets or urinals should be individually vented.

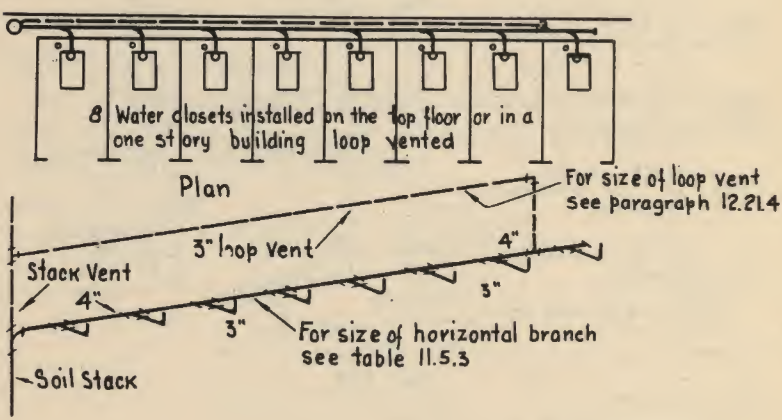


Fig. 147

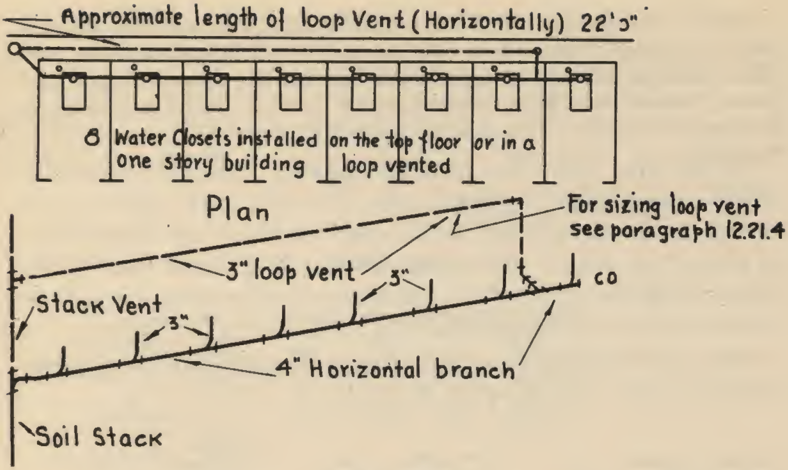


Fig. 147a

Fig. 148 illustrates a toilet arrangement similar to that shown in Fig. 147 except that the installation applies to a multi-story building.

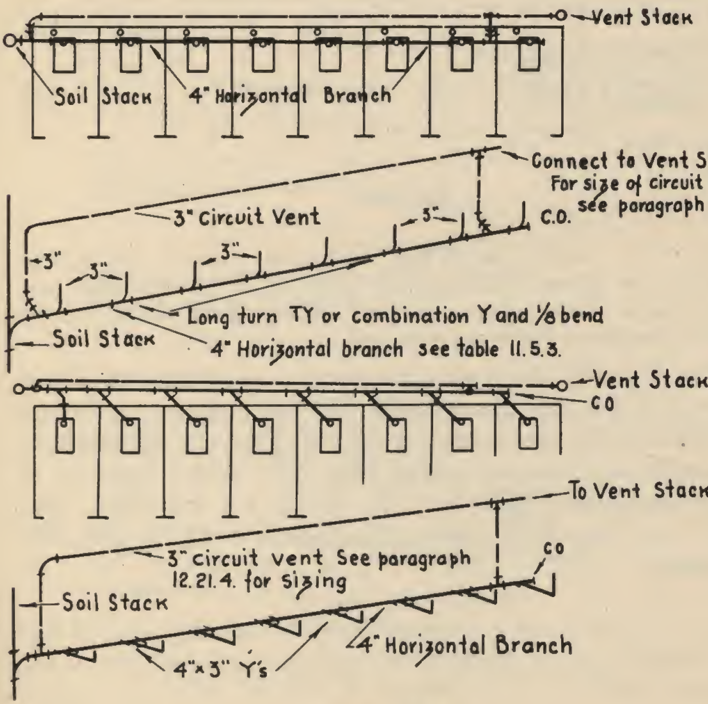


Fig. 148

12.15.2 *Dual branches*—When parallel horizontal branches serve a total of 8 water closets (4 on each branch), each branch shall be provided with a relief vent at a point between the two most distant water closets. When other fixtures (than water closets) discharge above the horizontal branch, each such fixture shall be vented.

NOTE: Fig. 149. The vent should be connected above the center line of the soil pipe, and the vent pipe should rise vertically, or at an angle of 45 degrees from the horizontal, to a point at least 6 inches above the flood-level rim of the fixture it is venting before offsetting horizontally, or before connecting to the branch vent.

The size of the loop or circuit vent is computed from table in paragraph 12.21.4. (See Fig. 160.)

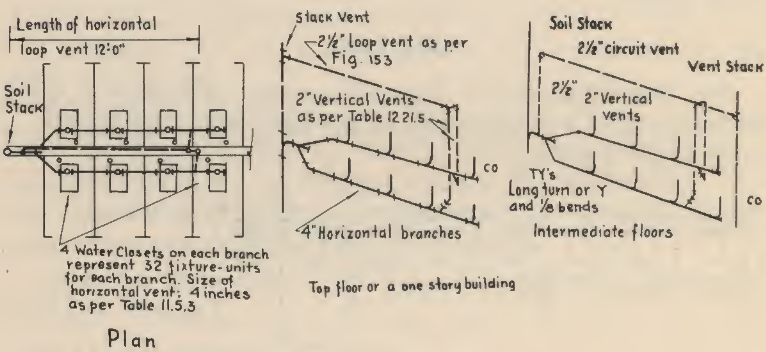


Fig. 149

12.15.3 *Vent connections*—When the circuit, loop, or relief vent connections are taken off the horizontal branch, the vent branch connection shall be taken off at a vertical angle or from the top of the horizontal branch.

NOTE: Fig. 150 illustrates this general requirement. When a branch vent is run horizontally, the backwash or ordinary flow through the waste or soil pipe will have a tendency to clog the horizontal portion of the vent unless there is a fixture connected above it in the form of a wet vent. The branch vent should be taken at a 45-degree angle from the horizontal.

Fig. 151 illustrates a loop and circuit-vented group of fixtures. Sketch (a) consists of water closets, urinals and lavatories in a row in an installation on the top floor of a build-

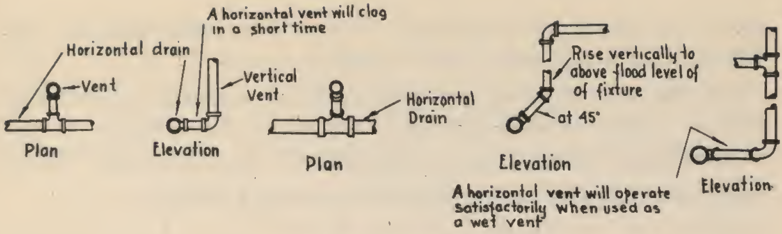


Fig. 150

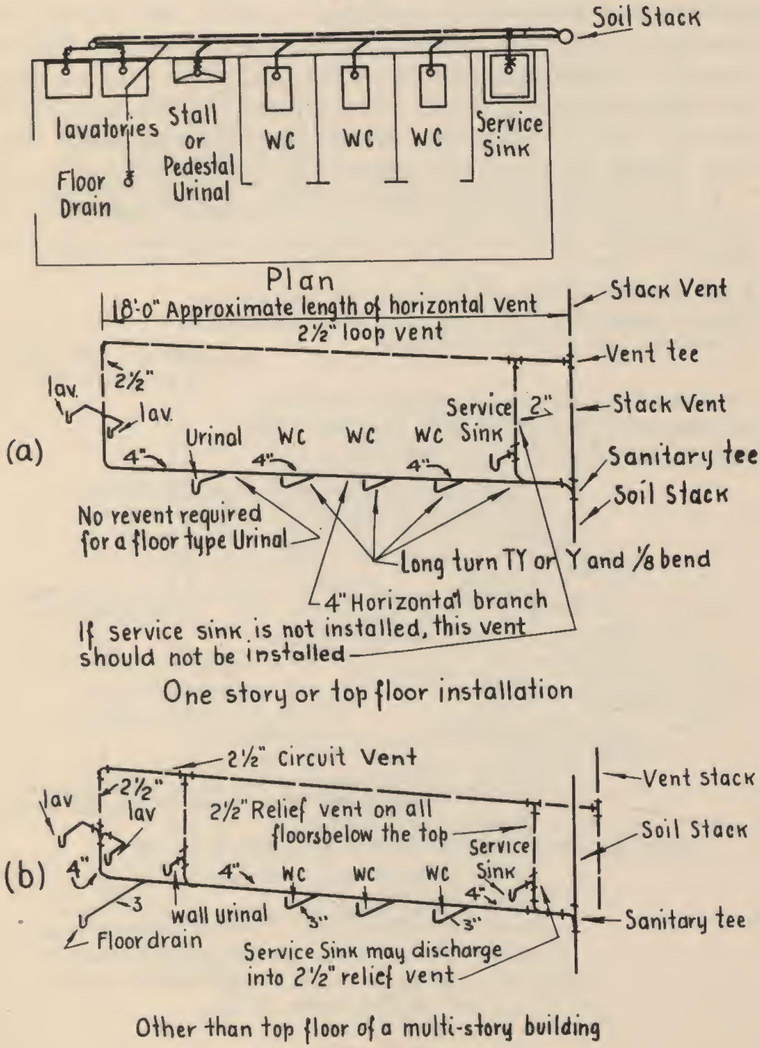


Fig. 151

ing or a one-story building. Where a service sink is not needed, the relief vent is not needed.

Sketch (b) shows a group of fixtures with the addition of a floor drain in a multi-story building. The length of unvented floor drain branch depends on its diameter. Table 12.9.3 shows length and diameter of pipe allowed.

Fig. 152. When circuit and loop-vented fixtures are installed in a multi-story building, a relief vent should be provided at the base connection into the horizontal. This is done by connecting the vent stack, full size, into or near the base of the soil stack, or by connecting the vent stack directly into the horizontal branch near the soil stack. The vent should be carried full size.

If the soil stack is carrying a load greater than 50% of the total allowed by table 11.5.3, it is desirable to connect

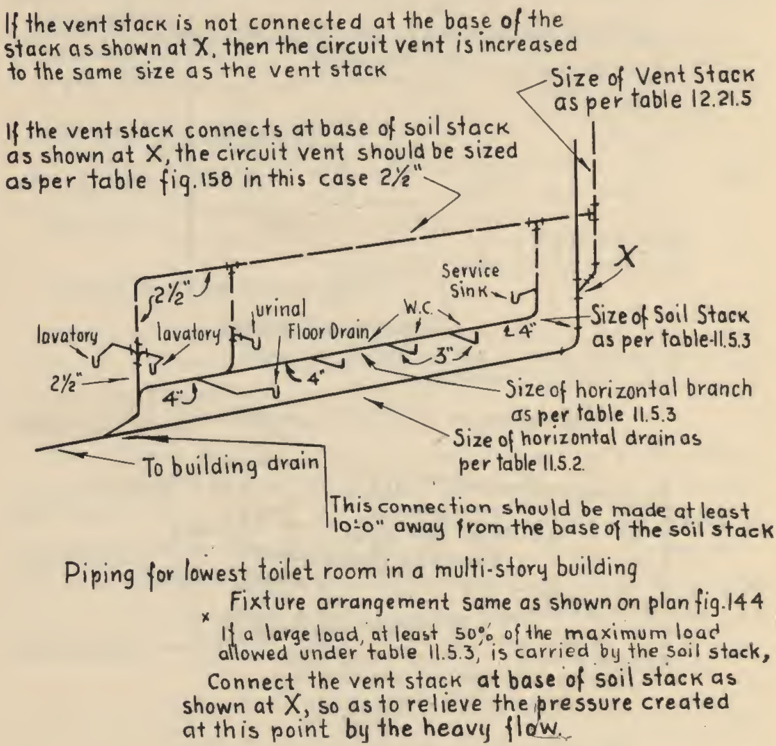


Fig. 152

the vent stack near the base of the soil stack and to carry the discharge from the toilet on the lowest floor at least 10 feet downstream from the point at which the soil stack becomes a horizontal drain. This will relieve some of the pressures which generally develop at the base of a soil stack.

12.15.4 *Fixtures back-to-back in battery*—When fixtures are connected to one horizontal branch through a double wye or a sanitary tee in a vertical position, a common vent for each 2 fixtures back-to-

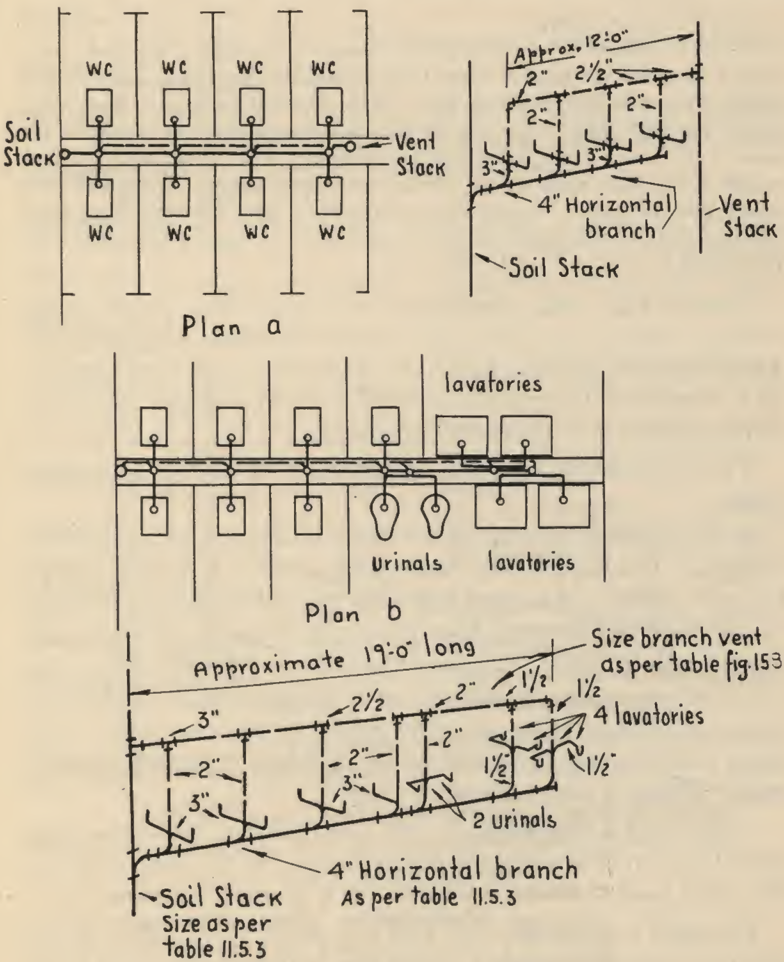


Fig. 153

back or double connection shall be provided. The common vent shall be installed in a vertical position as a continuation of the double connection.

NOTE: Fig. 15[stain] illustrates fixtures back-to-back in battery: (a) when water closets are installed on top floor or any floor in a multi-story building; (b) when mixed fixtures are installed on the same horizontal branch.

When blow-out type water closets or blow-out type urinals are used, they should be individually vented.

12.17 RELIEF VENTS.

12.17.1 *Stacks of more than 10 branch intervals*—Soil and waste stacks in buildings having more than 10 branch intervals shall be provided with a relief vent at each 10th interval installed, beginning with the top floor. The size of the relief vent shall be equal to the size of the vent stack to which it connects. The lower end of each relief vent shall connect to the soil or waste stack through a wye below the horizontal branch serving the floor, and the upper end shall connect to the vent stack through a wye not less than 3 feet above the floor level.

NOTE: Fig. 154 illustrates an important requirement which is often overlooked. In order to balance the pressures which are constantly changing within the plumbing system, it is necessary to provide a relief vent at various intervals, particularly in multi-story buildings.

The illustration shows a building of 16 stories and basement.

A horizontal branch connection is shown at each floor except at the eighth-floor level where there is no horizontal branch. This means that between the ninth-floor horizontal branch and the seventh-floor horizontal branch, there is only one branch interval. Between the fifth and fourth floors, the illustration shows two horizontal branches within one branch interval. The purpose in differentiating between horizontal lines and branch intervals is to prevent overloading of a stack within a short space.

Table 11.5.3 indicates, in the first column, the total load permitted in a horizontal branch and, in the last column, the total load that can be placed in a branch interval.

Example: Asuming that the soil stack is 4 inches in diameter, the total number of fixture units allowed on a horizontal branch according to table 11.5.3 is 160, but only 90 fixture-units are permitted on the branch interval. It is

necessary to increase the size of the soil stack or reduce the number of fixture-units on the horizontal branch so that the system is not overloaded at any one point.

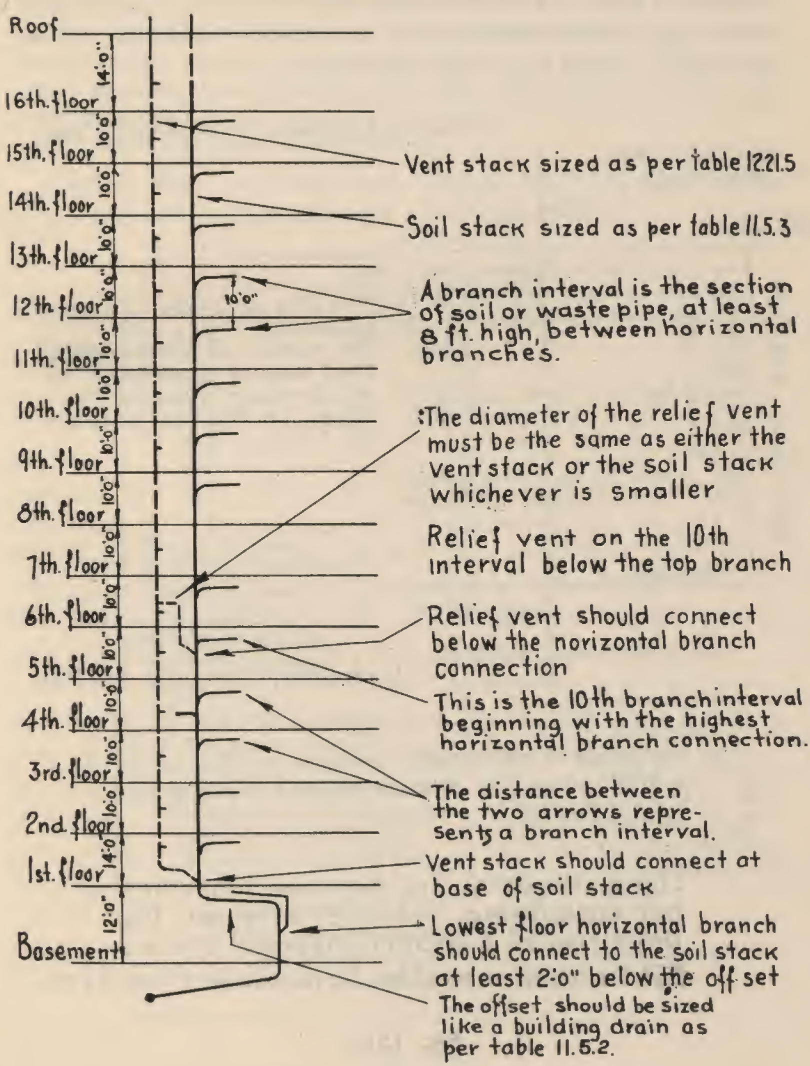


Fig. 154

NOTE: Assume that there are two horizontal branches to be connected within one branch interval of the soil stack.

One branch serves 50 fixture-units, and the other 40 fixture-units, totaling 90 fixture-units. This is the maximum that may be connected within one branch interval. (See table 11.5.3.) If the total fixture-units were more than permitted within one branch interval, the soil stack would have to be increased in order to prevent overloading.

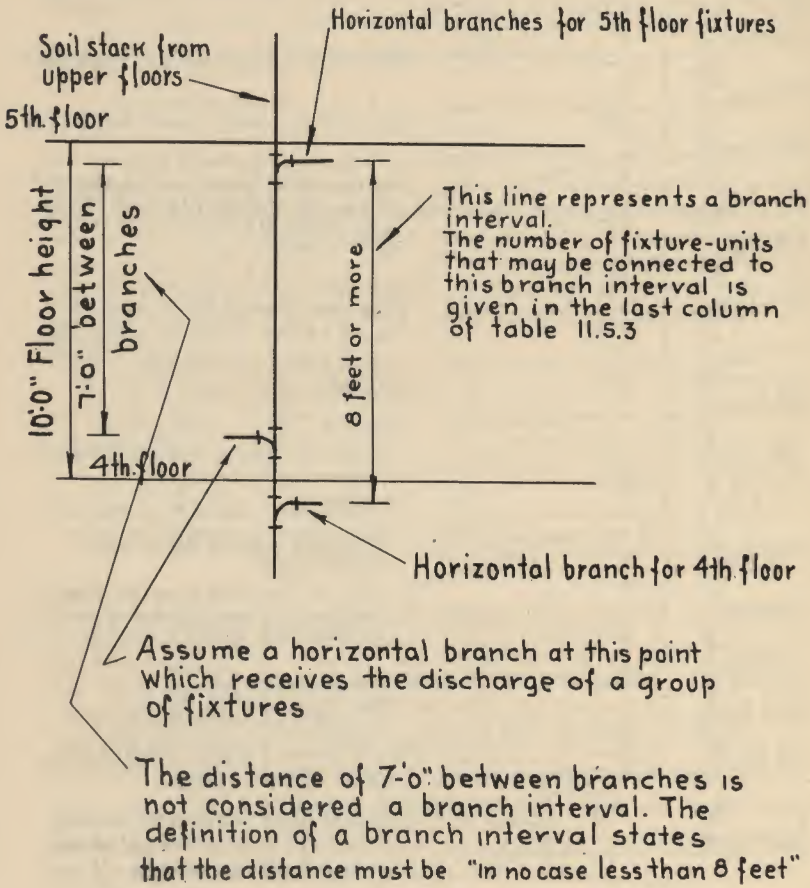


Fig. 155

12.18 Offsets at an angle less than 45 degrees from the horizontal in buildings of 5 or more stories.

12.18.1 *Offset vents*—Offsets less than 45 degrees from the horizontal, in a soil or waste stack, except as permitted in section 11.6, shall comply with paragraphs 12.18.2 and 12.18.3.

12.18.2 *Separate venting*—Such offsets may be vented as 2 separate soil or waste stacks, the stack section below the offset and the stack section above the offset.

12.18.3 *Offset reliefs*—Such offsets may be vented by installing a relief vent as a vertical continuation of the lower section of the stack or as a side vent connected to the lower section between the offset and the next lower fixture or horizontal branch. The upper section of the offset shall be provided with a yoke vent. The diameter of the vents shall be not less than the diameter of the main vent, or of the soil and waste stack, whichever is the smaller.

NOTE: Fig. 156 illustrates venting required for offsets. Also refer to paragraph 11.6 and illustrations.

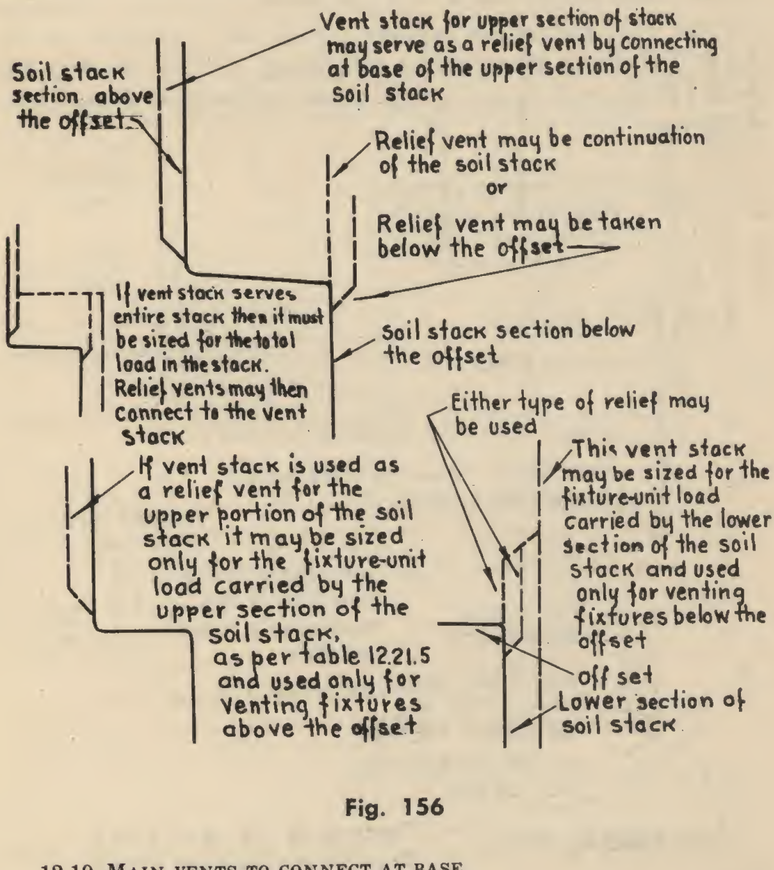


Fig. 156

12.19 MAIN VENTS TO CONNECT AT BASE.

12.19.1 All main vents or vent stacks shall connect full size at their base to the building drain or to the main soil or waste pipe, at or below the lowest fixture branch. All vent pipes shall extend undi-

minished in size above the roof, or shall be reconnected with the main soil or waste vent.

Fig. 157 illustrates the requirements of this paragraph, as follows:

(a) Vent stack is connected at the base of the soil stack, and extended through the roof.

(b) Vent stack may be combined with the stack vent and then extended through the roof as one pipe.

(c) Vent stack may be combined with the soil stack and connect into a vent header.

(d) Vent stack may connect into the horizontal portion at the base of the stack. In all cases, if possible, the discharge of a fixture or fixtures should be connected at the base of the vent stack before offsetting. In this manner the base of the vent stack is kept clear by the flow from these fixtures.

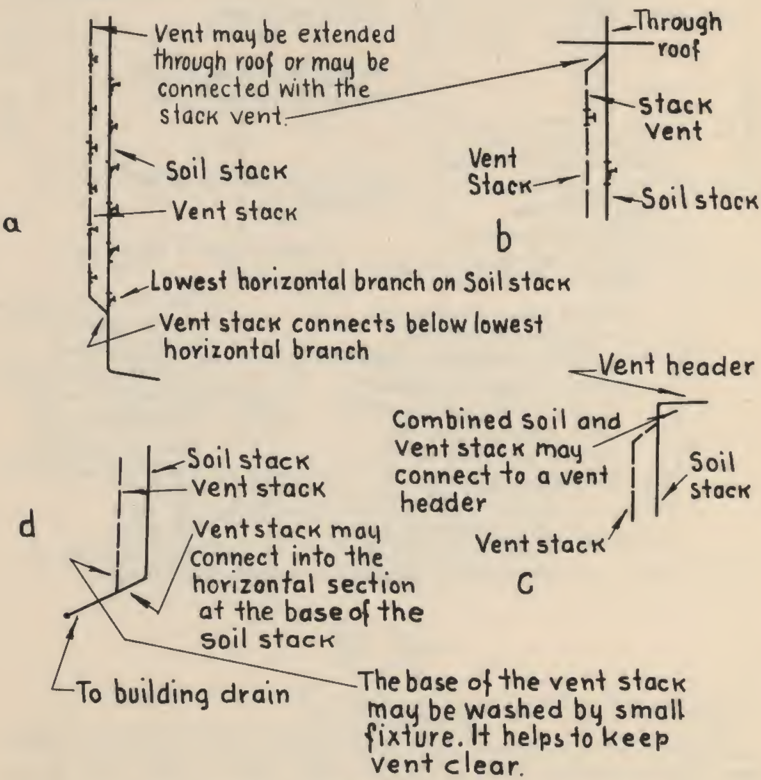
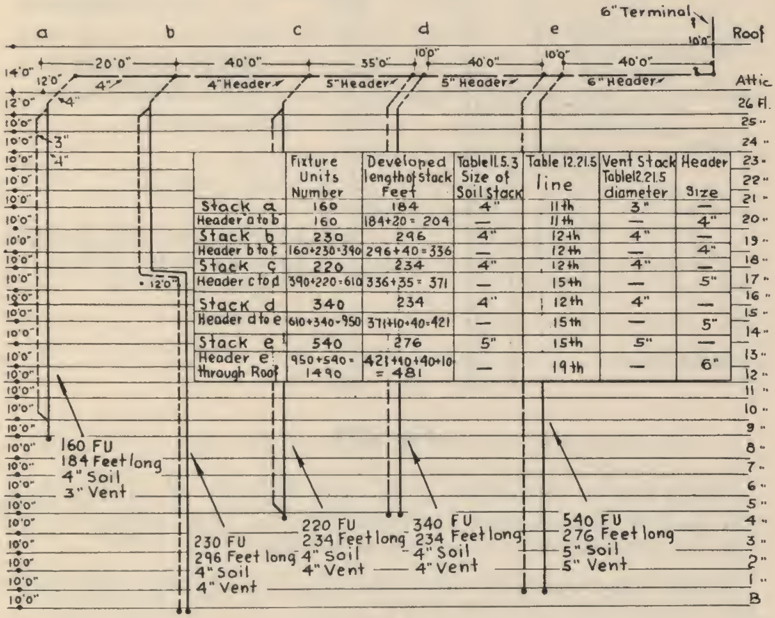


Fig. 157

12.20 VENT HEADERS.

12.20.1 *Connections of vents*—Stack vents and vent stacks may be connected into a common vent header at the top of the stacks and then extended to the open air at one point. This header shall be sized in accordance with the requirements of table 12.21.5, the number of units being the sum of all units on all stacks connected thereto and the developed length being the longest vent length from the intersection at the base of the most distant stack to the vent terminal in the open air as a direct extension of one stack.

NOTE: Fig. 158 illustrates the method of computing vent stack size and grouping into a vent header. The example shows how each stack is computed as part of the entire header.



	Fixture Units Number	Developed length of stack Feet	Table 11.5.3 Size of Soil Stack	Table 12.21.5 line	Vent Stack Table 12.21.5 diameter	Header Size
Stack a	160	184	4"	11th	3"	—
Header a to b	160	184+20 = 204	—	11th	—	4"
Stack b	230	296	4"	12th	4"	—
Header b to c	160+230=390	296+40=336	—	12th	—	4"
Stack c	220	234	4"	12th	4"	—
Header c to d	390+220=610	336+35 = 371	—	15th	—	5"
Stack d	340	234	4"	12th	4"	—
Header d to e	610+340=950	371+10+40=421	—	15th	—	5"
Stack e	540	276	5"	15th	5"	—
Header e through Roof	950+540= 1490	421+10+40+10 = 481	—	19th	—	6"

Fig. 158

12.21 SIZE AND LENGTH OF VENTS.

12.21.1 *Length of vent stacks*—The length of the vent stack or main vent shall be its developed length from the lowest connection of the vent system with the soil stack, waste stack, or building drain to the vent stack terminal, if it terminates separately in the open air, or to the connection of the vent stack with the stack vent, plus the developed length of the stack-vent from the connection to the terminal in the open air, if the two vents are connected together with a single extension to the open air.

NOTE: Fig. 159 illustrates manner in which the length of the vent or soil stack is computed. The total vertical distance is added to any horizontal runs or offsets.

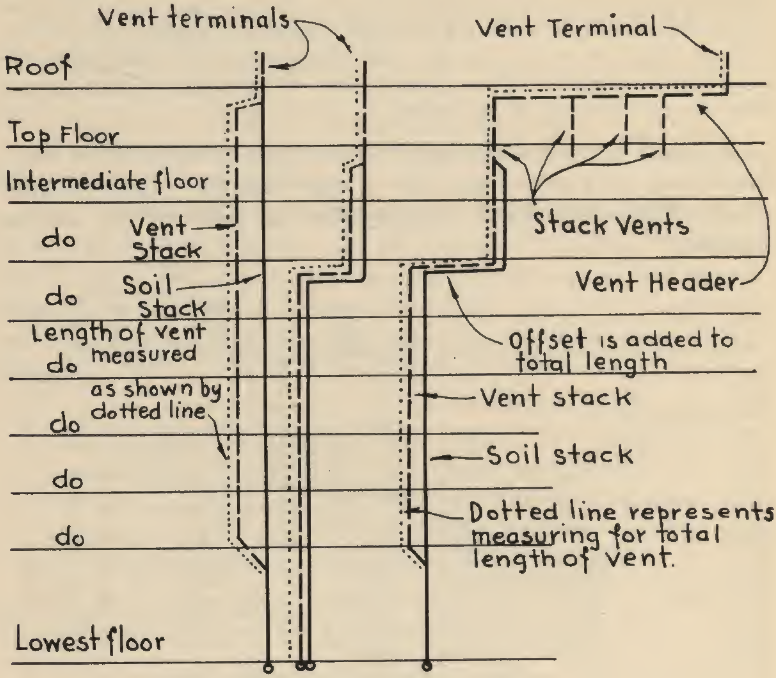


Fig. 159

12.21.2 *Size of individual vents*—The diameter of an individual vent shall be not less than 1¼ inches nor less than one-half of the diameter of the drain to which it is connected.

NOTE: The smallest vent permitted is 1¼-inch diameter pipe. Note that table 12.21.5 permits only 2 fixture-units on a 1¼-inch diameter vent. However, when a vent is used as a relief on a horizontal waste or vertical soil, the vent may be reduced to half of the drain diameter provided the number of fixture-units connected, or the length of the vent do not exceed the limit provided in table 12.21.5.

12.21.3 *Size of relief vent*—The diameter of a relief vent shall be not less than one-half the diameter of the soil or waste branch to which it is connected.

NOTE: The vent must be computed from table 12.21.5 also.

12.21.4 *Size of circuit or loop vent*—The diameter of a circuit or loop vent shall be not less than one-half the size of the diameter of the horizontal soil or waste branch or the diameter of the vent stack, whichever is smaller.

NOTE: See Figs. 147 to 154.

HORIZONTAL CIRCUIT AND LOOP VENT SIZING TABLE

Line No.	Soil or waste pipe diameter (inches)	Fixture-units: Number not exceeding	Diameter of circuit or loop vent					
			1½″	2″	2½″	3″	4″	5″
			Horizontal length, not exceeding (feet)					
1	1½	10	20					
2	2	12	15	40				
3	2	20	10	30				
4	3	10		20	40	100		
5	3	30			40	100		
6	3	60			16	80		
7	4	100		7	20	52	200	
8	4	200		6	18	50	180	
9	4	500			14	36	140	
10	5	200				16	70	200
11	5	1100				10	40	140

Fig. 160

Table, Fig. 160 may be used in the following manner:

(a) Refer to Fig. 149 which shows there are 8 flush valve water closets to be installed.

(b) Table 11.4.2 indicates that a valve-operated water closet has a fixture-unit value of 8.

(c) Fig. 148 shows there are 8 water closets to be installed, each with a value of 8 or a total of 64 fixture-units.

(d) 64 fixture-units require a 4-inch horizontal branch according to table 11.5.3.

(e) By referring to Fig. 148, the length of the horizontal vent is approximately 24 feet.

(f) By referring to table, Fig. 160, a 4-inch diameter soil or waste pipe, to which there are not more than 100 fixture-units connected and in which the vent length is not more than 52 feet long, requires a 3-inch diameter circuit or loop vent.

12.21.5 *Size of vent piping*—The size of vent piping shall be determined from its length and the total of fixture-units connected thereto, as provided in table 12.21.5. Twenty per cent of the total length may be installed in a horizontal position.

TABLE 12.21.5 *Size and length of vents*

Size of soil or waste stack (inches)	Fixture units connected	Diameter of vent required (inches)								
		1¼	1½	2	2½	3	4	5	6	8
		Maximum length of vent (feet)								
1¼	2	30	----	----	----	----	----	----	----	----
1½	8	50	150	----	----	----	----	----	----	----
1½	10	30	100	----	----	----	----	----	----	----
2	12	30	75	200	----	----	----	----	----	----
2	20	26	50	150	----	----	----	----	----	----
2½	42	----	30	100	300	----	----	----	----	----
3	10	----	30	100	200	600	----	----	----	----
3	30	----	----	60	200	500	----	----	----	----
3	60	----	----	50	80	400	----	----	----	----
4	100	----	----	35	100	260	1,000	----	----	----
4	200	----	----	30	90	250	900	----	----	----
4	500	----	----	20	70	180	700	----	----	----
5	200	----	----	----	35	80	350	1,000	----	----
5	500	----	----	----	30	70	300	900	----	----
5	1,100	----	----	----	20	50	200	700	----	----
6	350	----	----	----	25	50	200	400	1,300	----
6	620	----	----	----	15	30	125	300	1,100	----
6	960	----	----	----	----	24	100	250	1,000	----
6	1,900	----	----	----	----	20	70	200	700	----
8	600	----	----	----	----	----	50	150	500	1,300
8	1,400	----	----	----	----	----	40	100	400	1,200
8	2,200	----	----	----	----	----	30	80	350	1,100
8	3,600	----	----	----	----	----	25	60	250	800
10	1,000	----	----	----	----	----	----	75	125	1,000
10	2,500	----	----	----	----	----	----	50	100	500
10	3,800	----	----	----	----	----	----	30	80	350
10	5,600	----	----	----	----	----	----	25	60	250

Laboratory investigations of capacities for soil, vent stacks, horizontal branches and building drains are now in progress and technical data and results will be made available in due time. Reports of previous studies conducted at the State University of Iowa and the National Bureau of Standards are recommended. (See Bibliography.)

12.22 COMBINATION WASTE-AND-VENT SYSTEM.

12.22.1 *Where permitted*—A combination waste-and-vent system shall be permitted only where structural conditions preclude the installation of a conventional system as otherwise provided in this code.

12.22.2 *Limits*—A combination waste-and-vent system is limited to floor drains and sinks. It consists of an installation of waste piping in which the trap of the fixture is not individually vented. Every waste pipe and trap in the system shall be at least 2 pipe sizes larger than the size required in tables 11.5.2 and 11.5.3.

NOTE: Fig 161 illustrates a system of waste piping which also serves as horizontal wet venting of one or more sinks or

floor drains. The dual function is accomplished by installing a common waste and vent pipe of sufficient size to provide free movement of air above the flow line of the drain. This system is relatively new, having been developed during the past few years.

The code permits a combination waste-and-vent system as a means of avoiding complicated design. The designer, however, must plan the sizing and runouts of piping necessary to maintain a balance within the system and prevent trap siphonage.

It should be noted that this combination waste-and-vent system is for floor drains and sinks only. It is not for water closets or urinals or other fixtures having high fixture-unit ratings. Toilet room fixtures are roughed in the conventional manner. Their discharge is carried separately to the building sewer or may be connected to the building drain on the sewer side of the combination waste-and-vent.

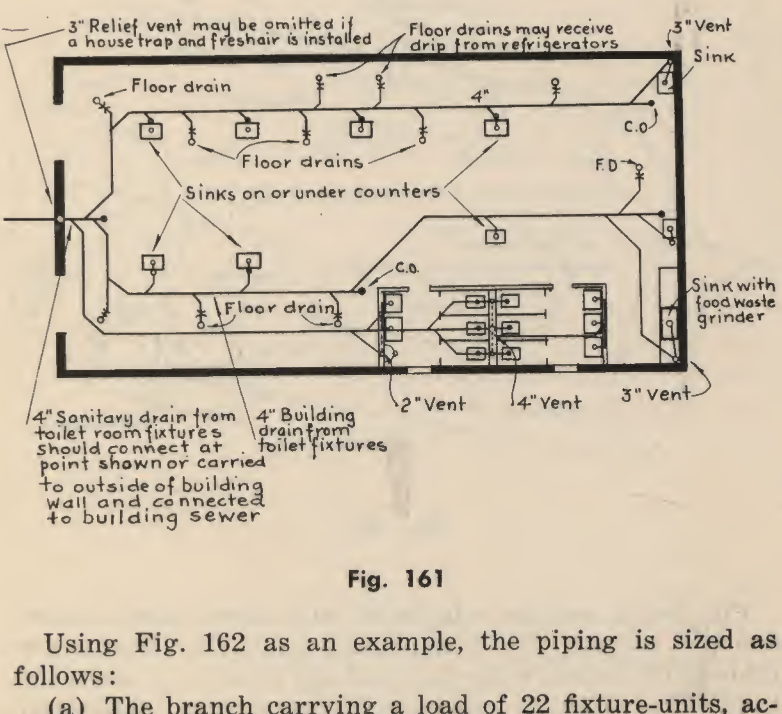


Fig. 161

Using Fig. 162 as an example, the piping is sized as follows:

(a) The branch carrying a load of 22 fixture-units, according to table 11.5.2 at ¼-inch fall per foot, requires a

2½-inch diameter pipe and for 18 fixture-units on the other branch, a 2-inch diameter pipe. Paragraph 12.22.2 states that the waste pipe shall be at least 2 pipe sizes larger. For 22 fixture-units it would be 4 inches and for 18 fixture-units it would be 3 inches.

(b) The individual fixture drain for a sink, as per table 11.4.2, is 1½-inch. By increasing this drain two pipe sizes, the required size would be 2½ inches for each sink waste.

(c) Table 11.4.2 requires 2 inches for individual floor drains as a minimum. Two pipe sizes would be 3 inches. If there is difficulty in procuring 2½-inch drainage fittings, 3-inch drainage fittings may be used.

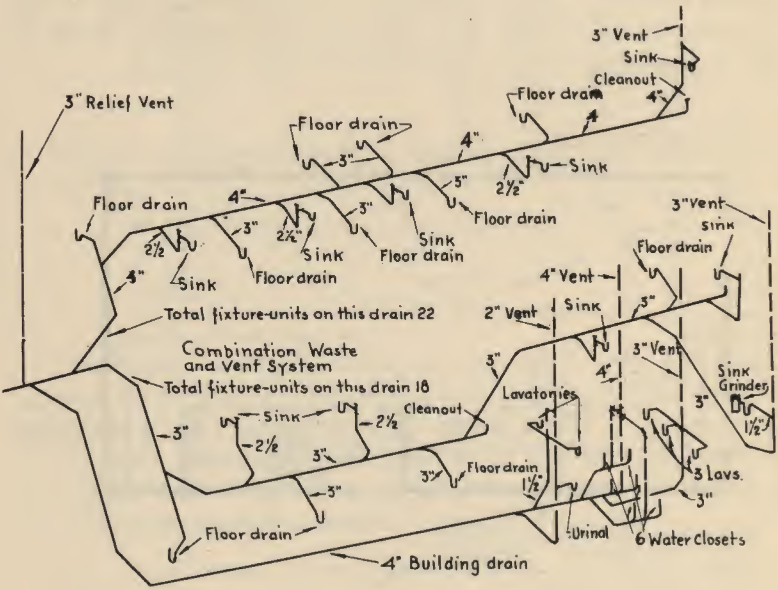


Fig. 162

Fig. 163 is another adaptation of a combination waste-and-vent system. This is applicable where the street sewer is above the system being installed and where it is necessary to install a receiving sump and discharge it by mechanical means.

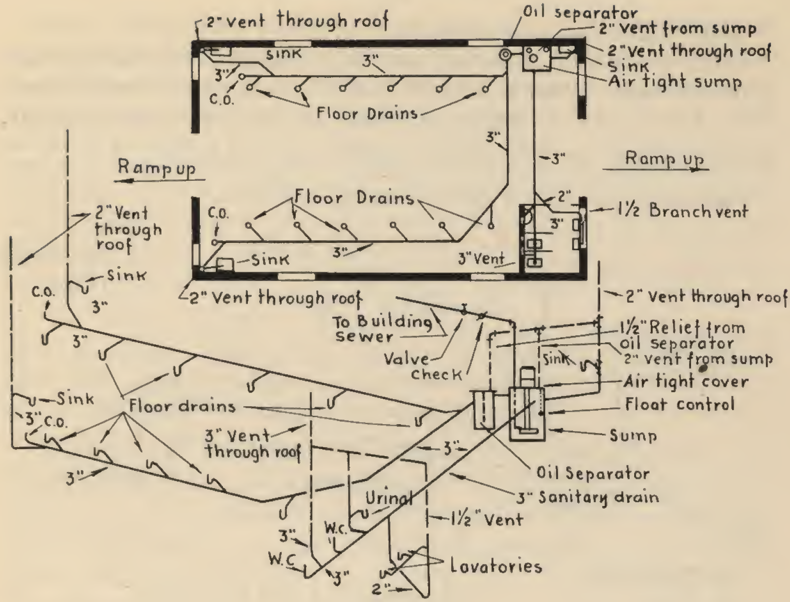

2" Vent through roof
Oil separator
2" Vent from sump
2" Vent through roof
Sink
Air tight sump
Sink
3"
3"
C.O.
Floor Drains
3"
3"
Ramp up
Ramp up
Floor Drains
C.O.
2"
1½ Branch vent
3"
Sink
3"
3" Vent
2" Vent through roof
2" Vent through roof
Sink
C.O.
3"
3"
2" Vent through roof
To Building sewer
1½" Relief from oil separator
Valve
Check
Sink
2" Vent from sump
Air tight cover
Float control
Sink
3" C.O.
Floor drains
Sump
3" Vent through roof
3"
Oil Separator
3"
3" Sanitary drain
Urinal
1½" Vent
3"
W.C.
W.C.
3"
Lavatories
2"

Fig. 163

STORM DRAINS

13.4 CONDUCTORS AND CONNECTIONS.

13.4.3 *Combining storm with sanitary drainage*—The sanitary and storm-drainage system of a building shall be entirely separate, except that where a combined sewer is available the building storm drain may be connected in the same horizontal plane through a single wye fitting to the combined drain or sewer at least 10 feet downstream from any branch to the building drain or from any soil stack.

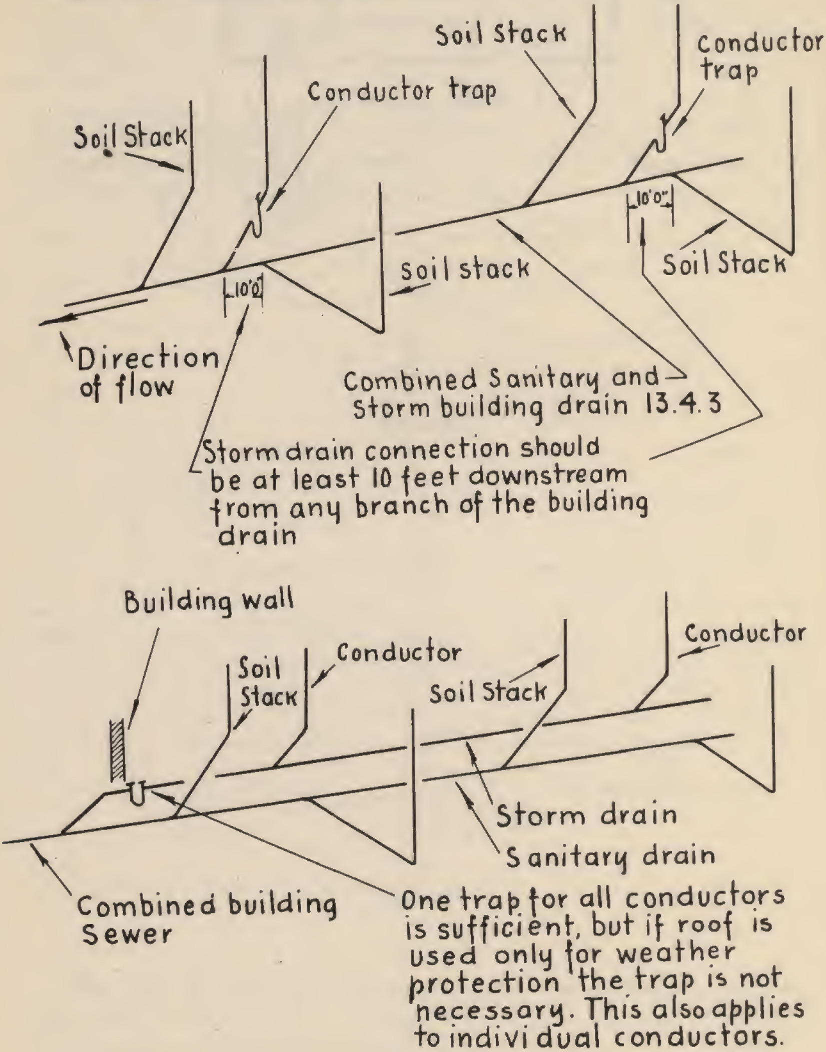


Fig. 164

NOTE: In certain cities it is permissible to connect both a sanitary and storm sewer into a combined street sewer. As populations increase and cities become more congested, this arrangement is becoming less prevalent.

Fig. 164 indicates how storm drains may be connected in locations which permit this combined use of the sewer. Some cities require that the storm drains discharge at the curb through a trench or pipe under the sidewalk. Separation of storm drains and sanitary drainage is preferable.

13.4.4 *Double connections of storm drains*—Where the sanitary and storm drains are connected on both sides of the combined sewer, single wyes shall be used and the requirements of paragraph 13.4.3 relative to the location of connections shall also apply.

NOTE: During a heavy rain storm the conductor pipe will run almost to its full capacity and may cause pressures to develop on the soil stack branch unless separated at least 10 feet. This is equally true of a soil stack carrying a relatively heavy load; see Fig. 165. If a 4-inch soil stack is loaded to 300 fixture-units or more, it represents a relatively heavy load. If the same stack is loaded to 400 fixture-units or more, it represents a full load.

13.4.5 Floor drains connected to a storm drain shall be trapped.

13.5 ROOF DRAINS.

13.5.1 *Material*—Roof drains shall be of cast iron, copper, lead, or other acceptable corrosion-resisting material.

13.5.2 *Strainers*—All roof areas, except those draining to hanging gutters, shall be equipped with roof drains having strainers extending not less than 4 inches above the surface of the roof immediately adjacent to the roof drains. Strainers shall have an available inlet area, above roof level, of not less than 1½ times the area of the conductor or leader to which the drain is connected.

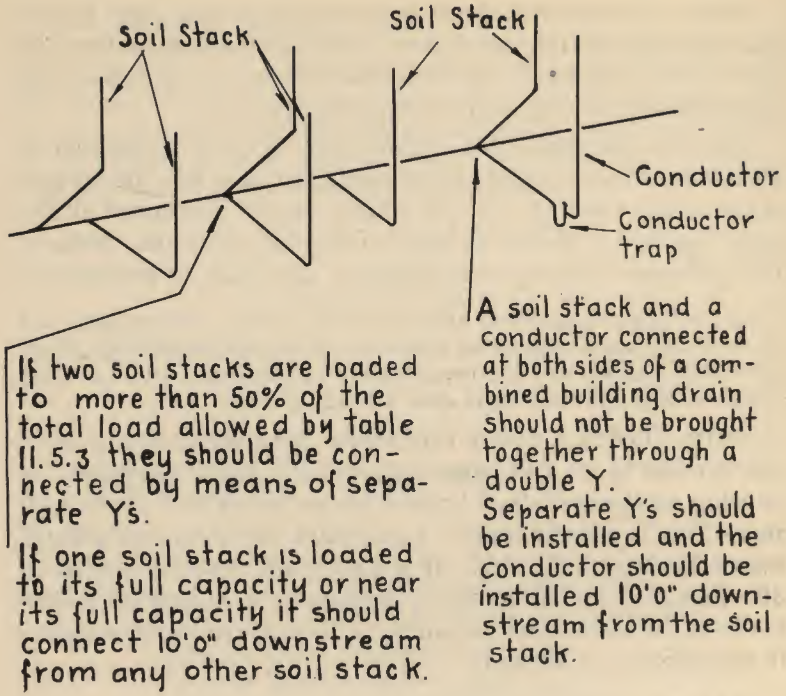
13.5.3 *Flat decks*—Roof drain strainers for use on sun decks, parking decks, and similar areas, normally serviced and maintained, may be of the flat surface type, level with the deck and shall have an available inlet area not less than two times the area of the conductor or leader to which the drain is connected.

13.5.4 *Roof drain flashings*—The connection between roofs and roof drains which pass through the roof and into the interior of the building shall be made watertight by the use of proper flashing material.

Fig. 166 illustrates general type of roof drains.

(a) applicable to paragraph 13.5.2.

(b) applicable to paragraph 13.5.3.



Double connection of storm drain 13.4.4.

Fig. 165

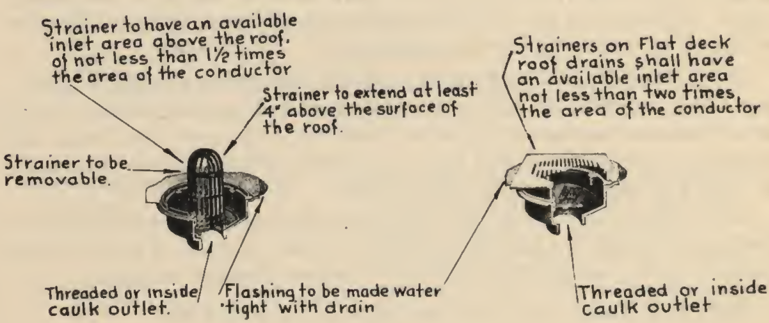


Fig. 166

13.6 Size of leaders and storm drains.

13.6.1 Vertical leaders shall be sized on the maximum projected roof area, according to the following table:

Table 13.6.1 *Size of vertical leaders*

Diameter of leader or conductor [1] (inches)	Maximum projected roof area (square feet)	Diameter of leader or conductor [1] (inches)	Maximum projected roof area (square feet)
2	720	5	8,650
2½	1,300	6	13,500
3	2,200	8	29,000
4	4,600		

[1] The equivalent diameter of a square or rectangular leader may be taken as the diameter of that circle which may be inscribed within the cross-sectional area of the leader.

Note.—See footnote to table 13.6.2.

Note: Following is an expansion of Table 13.6.1 showing sizes of vertical leaders for rainfalls from 2 to 8 inches.

Expansion of Table 13.6.1—Vertical Leaders

Diameter of leader (inches)	Normal Rate of Rainfall					
	2″	3″	4″	5″	6″	8″
	Square feet of roof area					
2	1440	960	720	576	540	360
2½	2600	1733	1300	1040	975	650
3	4400	2933	2200	1760	1650	1100
4	9200	6133	4600	3680	3450	2300
5			8650	6920	6500	4325
6						6750

13.6.2 *Building storm drain*—The size of the building-storm drain or any of its horizontal branches having a slope of one-half inch or less per foot, shall be based upon the maximum projected roof area to be handled according to the following table:

Table 13.6.2 *Size of horizontal storm drains*

Diameter of drain (inches)	Maximum projected roof area for drains for various slopes		
	⅛ inch	¼ inch	½ inch
	Square feet	*Square feet*	*Square feet*
3	822	1,160	1,644
4	1,880	2,650	3,760
5	3,340	4,720	6,680
6	5,350	7,550	10,700
8	11,500	16,300	23,000
10	20,700	29,200	41,400
12	33,300	47,000	66,600
15	59,500	84,000	119,000

Tables 13.6.1 and 13.6.2 are based upon a maximum rate of rainfall of 4 inches per hour. If in any state, city, or other political subdivision, the maximum rate of rainfall is more or less than 4 inches per hour, then the figures for roof area must be adjusted proportionately by multiplying the figure by 4 and dividing by the maximum rate of rainfall in inches per hour.

The U. S. Weather Bureau maintains statistics on the normal rate of rainfall in various localities and will furnish the information on request.

NOTE: Following is an expansion of Table 13.6.2 showing sizes of horizontal storm drains for rainfalls from 2 to 6 inches.

EXPANSION OF TABLE 13.6.2—HORIZONTAL STORM DRAINS

Size	⅛″ Slope Inches Rainfall					¼″ Slope Inches Rainfall				
Drain	2″	3″	4″	5″	6″	2″	3″	4″	5″	6″
inches	Square Feet of Roof Area									
3	1644	1096	822	657	548	2320	1546	1160	928	773
4	3760	2506	1880	1504	1253	5300	3533	2650	2120	1766
5	6680	4453	3340	2672	2227	9440	6293	4720	3776	3146
6	10700	7133	5350	4280	3566	15100	10066	7550	6040	5033
8	23000	15333	11500	9200	7600	32600	21733	16300	13040	10866

NOTE: Fig. 167 is a table showing approximately equivalent sizes of round and rectangular leaders. In computing carrying capacity of leaders, there are three factors to consider: (1) dimensions, (2) cross-sectional area, and (3) inside perimeter (area of water contact).

A rectangular leader, due to its four walls and corners, offers greater friction loss, thereby diminishing its carrying capacity. To compensate for this loss, a rectangular leader needs to be about 10 per cent larger than a round leader to carry the same load.

In Fig. 167 the sizes for rectangular leaders which are shown as equivalents of sizes of round leaders include the 10 per cent adjustment. In some cases, the rectangular sizes are more than 10 per cent larger. Where the computation of equivalent size has resulted in unavailable size, the next larger stock size has been given.

Round Leader			Rectangular Leader		
Diameter inches	Cross sectional area, sq. in.	Water contact area, inches	Dimension inches	Cross sectional area sq. in.	Water Contact area, inches
2	3.14	6.28	2×2 1½×2½	4. 3.75	8 8
3	7.07	9.42	2×4 2½×3	8 7.50	12 11
4	12.57	12.57	3×4¼ 3½×4	12.75 14.0	14.5 14
5	19.06	15.07	4×5 4½×4½	20.0 20.25	18. 18.
6	28.27	18.85	5×6 5½×5½	30.0 30.25	22. 22.
			2½" 1½		
		Circumference as straight line			Rectangle as straight line

Fig. 167

13.6.3 *Roof gutters*—The size of semicircular gutters shall be based on the maximum projected roof area, according to the following table:

TABLE 13.6.3 *Size of gutters*

Diameter of gutter [1] (inches)	Maximum projected roof area for gutters of various slopes			
	1/16 inch	⅛ inch	¼ inch	½ inch
	Square feet	*Square feet*	*Square feet*	*Square feet*
3	170	240	340	480
4	360	510	720	1,020
5	625	880	1,250	1,770
6	960	1,360	1,920	2,770
7	1,380	1,950	2,760	3,900
8	1,990	2,800	3,980	5,600
10	3,600	5,100	7,200	10,000

[1] Gutters other than semicircular may be used provided they have an equivalent cross-sectional area.

NOTE: Fig. 168 illustrates comparative sizing for semicircular and rectangular gutters which aid in computing sizes. Method of selecting sizes is similar to that of circular and rectangular leaders.

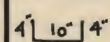
Semi-circular Gutters			Rectangular Gutters		
Diameter inches	Cross Sectional area, Sq. in	Water contact area, inches	Dimension inches	Cross Sectional area, Sq. in	Water contact area, inches
3	3.53	4.10	1½ × 2½	3.75	5.5
4	6.28	6.28	2¼ × 3	6.75	7.5
5	9.82	7.85	4 × 2½ 3 × 3½	10. 10.	9 9½
6	14.14	9.43	3 × 5	15	11.
8	25.27	12.57	4½ × 6	27.	15
10	39.77	15.7	5 × 8 4 × 10	40 40	18 18
		 Semi-circle as straight line			 Rectangle as straight line

Fig. 168

13.7 SIZE OF COMBINED DRAINS AND SEWERS.

13.7.1 Conversion of roof area to fixture-units of storm drains may be connected to a combined sewer. The drainage area may be converted to equivalent fixture-unit loads.

13.7.2 When the total fixture-unit load on the combined drain is less than 256 fixture-units, the equivalent drainage area in horizontal projection shall be taken as 1,000 square feet.

13.7.3 When the total fixture-unit load exceeds 256 fixture-units, each fixture-unit shall be considered the equivalent of 3.9 square feet of drainage area.

13.7.4 If the rainfall to be provided for is more or less than 4 inches per hour, the 1,000-square-foot equivalent in paragraph 13.7.2 and the 3.9 in paragraph 13.7.3 shall be adjusted by multiplying by 4 and dividing by the rainfall in inches per hour to be provided for.

NOTE: When a combined storm and sanitary sewer is to be computed the area of the roof (in square feet) should be converted into fixture-units in order to get the total load in fixture-units. Then, the size of the drain may be computed from table 11.5.2.

Example: Assume 4600 square feet of roof area on the storm drainage system is to be connected into a sanitary drain carrying 700 fixture-units.

The first 1000 sq. ft.	256 fu
Remaining 3600 sq. ft. divided by 3.9	923 fu
Subtotal 4600 sq. ft.	1179 fu
Add sanitary drainage system	700 fu
Grand total	1879 fu

According to table 11.5.2, 1879 fixture-units require a 10-inch diameter drain.

The conversion of roof area to fixture-units is based on a 4-inch rate of rainfall. If a different rate of rainfall is used, the computation changes proportionately.

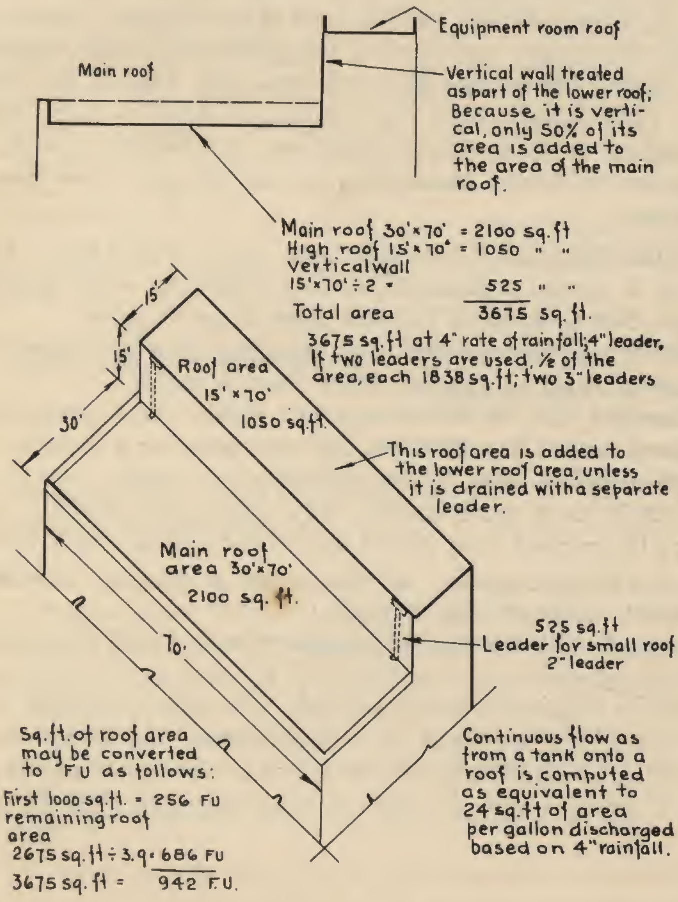


Fig. 169

13.8 VALUES FOR CONTINUOUS FLOW.

13.8.1 Where there is a continuous or semicontinuous discharge into the building storm drain or building storm sewer, as from a pump, ejector, air-conditioning plant, or similar device, each gallon per minute of such discharge shall be computed as being equivalent to 24 square feet of roof area, based upon a 4-inch rainfall. [See Figs. 98 and 99.]

NOTE: Allow for the extension of walls above the building and the amount of rain that should be considered for run-off of the roof area itself. Fig. 169 illustrates this condition for a flat roof. The roof area would then be 70 feet by 30 feet or 2,100 square feet. The wall area is 15 feet by 70 feet, or 1,050 square feet. However, the wall area would not represent 100% of the required drainage area. One-half of the wall area is sufficient in calculating the proper drainage. Add 2,100 square feet roof area plus half of the wall area (525 square feet) or a total of 2,625 square feet. According to table 13.6.1, 2,625 sq. ft. require a 4-inch-diameter conductor based on a normal rainfall of 4 inches per hour.

In the National Plumbing Code, after tables 13.6.1 and 13.6.2, is given a formula for adjusting the roof area in square feet to rates of rainfall other than 4 inches.

Below is a formula for proportioning sizes of leaders or drains to rates of rainfall other than 4 inches:

Example (a) for 5-inch rainfall: Table 13.6.1 prescribes a 3-inch leader for 2200 sq. ft. roof area in a locality of 4-inch rainfall. For 5-inch rainfall, this leader would be too small, as it could handle only 4/5 of the rainfall. To figure the correct size, invert 4/5 to 5/4 and multiply by 3: $\frac{5 \times 3}{4} = 3.75$-inch leader. As this is not a standard size, use the next standard size, 4-inch.

Example (b) for 3-inch rainfall: Table 13.6.2 prescribes a 6-inch storm drain for 7500 sq. ft. roof area at $\frac{1}{4}$-inch slope in a locality of 4-inch rainfall. For 3-inch rainfall, this drain would be too large, as it could handle 4/3 of the load. To figure the correct size, invert 4/3 to 3/4 and multiply by 6: $\frac{3 \times 6}{4} = 4.5$ inch drain. Use the next standard size, 5-inch.

SIZING THE WATER SUPPLY SYSTEM

Appendix D of the National Plumbing Code gives much information pertaining to water pressures, friction losses, and gpm demands of plumbing fixtures. The tables and graphs help compute correct sizes of piping requirements.

Below is a description of how these tables and graphs are used, step by step, in sizing piping. The example used is a layout for a 2-story and basement house. See Fig. 170.

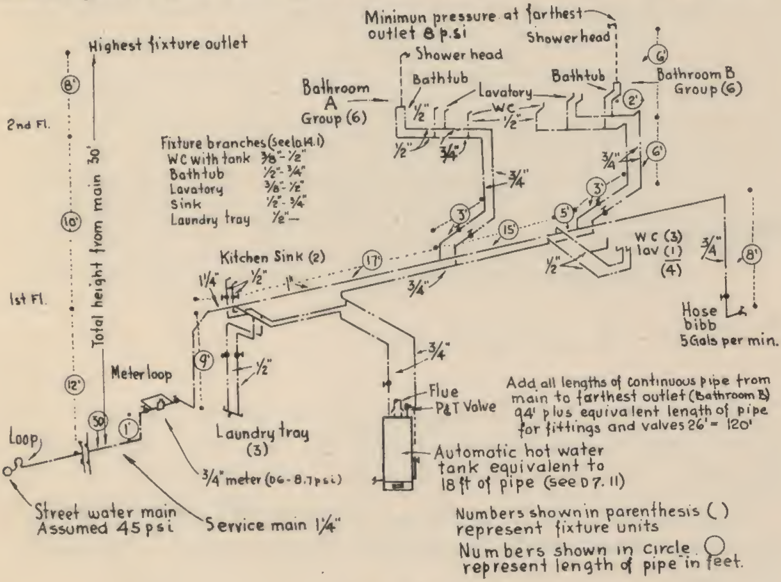


Fig. 170

The pipe sizing was computed from charts and tables in Appendix D, as follows:

Step 1

Compute total fixture-units from table D.3.5, "Demand weight of fixtures in fixture-units." *Answer*: 21 fu.

Bathroom group A	6	fixture-units
Bathroom group B	6	" "
Water closet, 1st floor	3	" "
Lavatory, 1st floor	1	" "
Kitchen sink	2	" "
Laundry tray, basement	3	" "
	21	" "

Step 2

Compute total water demand. *Answer*: 20 gpm.

Follow the heavy line on chart D.2. The estimated peak demand is 15 gpm to which is added 5 gpm for the hose bibb. The system uses flush tanks; therefore curve "2" is applicable.

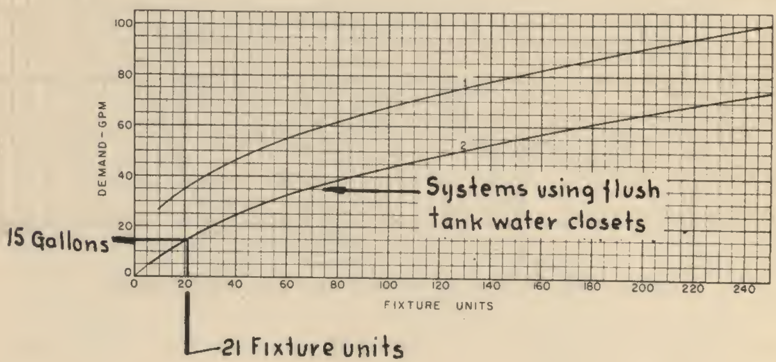


Fig. 171

Step 3

Compute the loss in pressure because of elevation of 30 feet from street main to highest fixture outlet. *Answer*: 13.02 psi.

Use the constant 0.434, which is the pressure per square inch in a column of water one foot high, multiplied by 30 feet. $30 \times 0.434 = 13.02$ psi.

Step 4

Compute the size of meter for a demand of 20 gpm. *Answer*: 3/4".

See table D.7.3, "Performance requirements of water meters." If no meter is installed, omit steps 4 and 5.

Step 5

Compute the pressure loss through the meter. *Answer*: 8.7 psi.

Compute this from chart D.6, "Pressure losses in disk-type water meters. (See Fig. 172.)

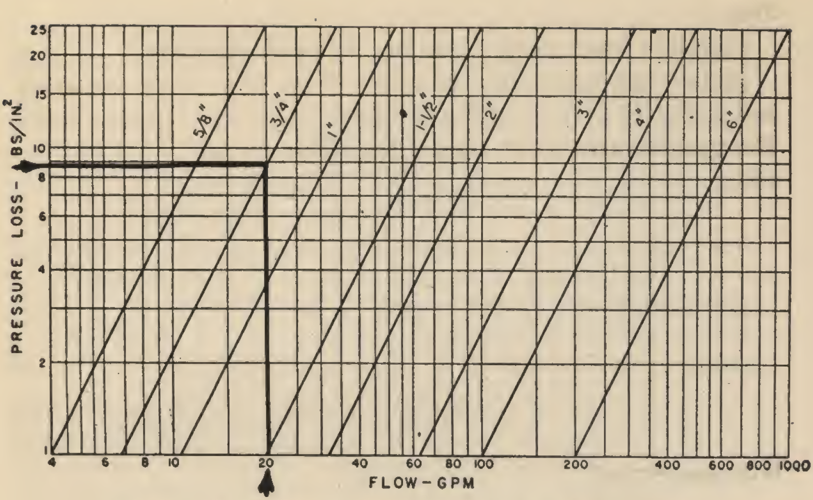


CHART D.6.—Pressure losses in disk-type water meters.

Fig. 172

D.7.2 Flow limits for disk-type meters, which may be regarded as the limits of recommended ranges in capacities. are given in table D.7.3. For information on other types of meters, the manufacturer should be consulted.

D.7.3.

TABLE D.7.3 *Performance requirements of water meters*[1]

Pipe size (inches)	Normal test-flow limits	Minimum test flow
	G. p. m.	*Hours*
⅝	1 to 20	¼
¾	2 to 34	½
1	3 to 53	¾
1½	5 to 100	1½
2	8 to 160	2
3	16 to 315	4
4	28 to 500	7
6	48 to 1,000	12

[1] American Water Works Association standards.

D.7.4 *Registration*—The registration on the meter dial shall indicate the quantity recorded to be not less than 98 percent nor more than 102 percent of the water actually passed through the meter while it is being tested at rates of flow within the specified limits (see table D.7.3) under normal test-flow limits. There shall be not less than 90 percent of the actual flow recorded when a test is made at the rate of flow set forth under minimum test flow.

Step 6

Compute available pressure after deducting pressure losses. *Answer*: 15.28 psi.

Pressure at the main, in this example		45.00 psi
Less losses:		
At the fixture outlet	8.00 psi	
From main to highest outlet	13.02 psi	
Through meter	8.70 psi	
Total losses		29.72 psi
Available pressure for overcoming friction resistance within piping		15.28 psi

Step 7

Compute developed length of piping from main in street to farthest outlet, which in this example is the shower head in bathroom B. *Answer*: 120 feet.

Length of main in street	30 feet
Length of rise to meter	1 "
Length of rise to ceiling	9 "
Length across ceiling of basement	40 "
Length of branch to bathroom B	8 "
Length to shower head, bathroom B	6 "
Length of fittings converted to equivalent piping lengths (See table D.7.9)	26 "
Developed length	120 "

Step 8

Compute pressure factor per 100 feet of developed length. *Answer*: 12.73 psi.

15.28 psi for 120 feet = 12.73 psi for 100 feet.

$$\frac{15.28 \times 100}{120} = 12.73.$$

Step 9

Compute diameter of service main to produce 20 gpm at a pressure of 15.28 psi, using galvanized ferrous piping.

Answer: 1¼″.

Velocity through piping should be not more than 10 fps in order to avoid water hammer and pipe noises.

Fig. 173 illustrates how to compute diameter of service main from chart D.4, "Friction loss during flow." When the computation results in a diameter which would be difficult to obtain, select the nearest larger size that would be readily obtainable.

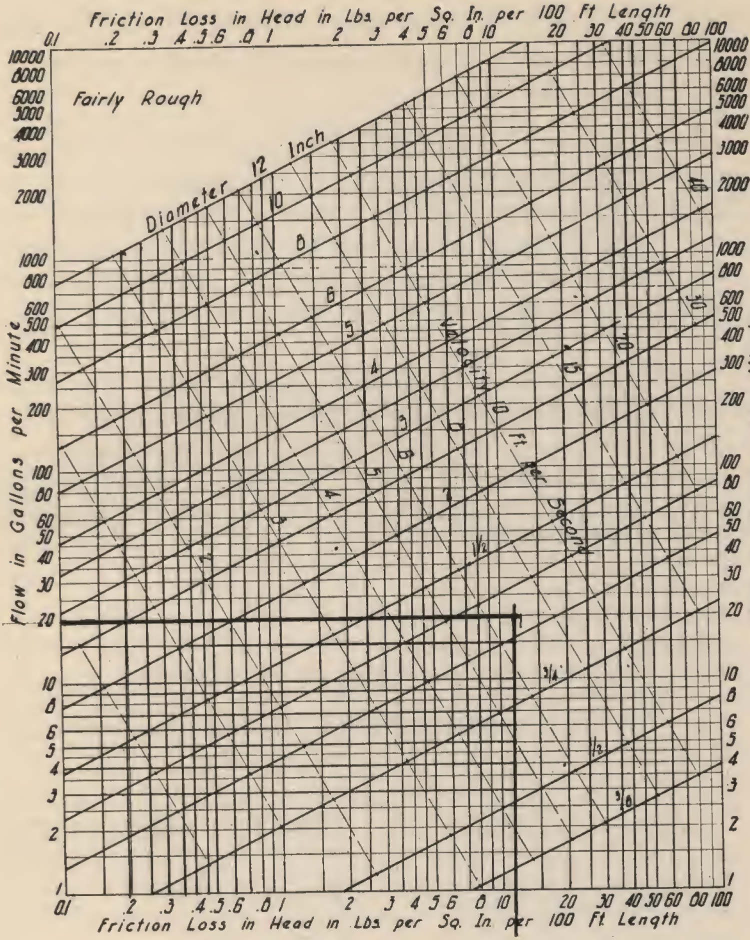


Fig. 173

Where water meter is not installed, the diameter of the service main would be: *Answer*: 1″.

Pressure at the main (street)		45.00 psi
Less losses:		
At the fixture outlet	8.00 psi	
From main to highest outlet	13.02 psi	
Total losses		21.02 psi
Available pressure for overcoming friction resistance within piping		23.98 psi

$$\frac{23.98 \times 100}{120} = 18.31 \text{ psi}$$

To produce 20 gpm at a pressure of 18.31 psi would require a 1″ diameter.

Step 10

Having determined the size of the meter, if one is installed, and the size of the service main, the pressure available for friction resistance within the piping, 12.73 psi, is then applied to sizing the principal branches of the water distributing systems. In this example, the three principal branches and the computations for sizing them are as follows:

(a) The branch through which all cold water is supplied to the two bathrooms and to the powder room:

Cold water fixture branch only	Fixture-Units table D.3.5 and note 3	Demand; chart D.2 (gpm)	Pipe size chart D.4 (inches)
3 water closets with flush tanks	3×3 =9.00		
2 bathtubs	¾ (2×2) =3.00		
3 lavatories	¾ (3×1) =2.25	11	
1 hose bibb		5	
Total	14.25	16	1

(b) The branch supplying the water heater, laundry tray and sink:

Cold water branch to heater	Fixture-Units table D.3.5 and note 3	Demand; chart D.2 (gpm)	Pipe size chart D.4 (inches)
1 kitchen sink, H & C	1×2 =2.00		
1 set laundry trays H & C	1×3 =3.00		
2 bathtubs CW only	¾ (2×2) =3.00		
3 lavatories CW	¾ (3×1) =2.25		
Total	10.25	8	¾

(c) The main hot water branch from water heater:

Main hot water branch	Fixture-Units table D.3.5 and note 3	Demand; chart D.2 (gpm)	Pipe size chart D.4 (inches)
2 bathtubs HW only	¾ (2×2) =3.00		
3 lavatories HW only	¾ (3×1) =2.25		
1 kitchen sink HW only	¾ (1×2) =1.50		
1 set laundry trays HW	¾ (1×3) =2.25		
Total	9.00	7	¾

Step 11

Compute the size of the branches for bathroom groups A and B as follows: in the same manner as the branches in Step 9(a), (b), and (c) were computed:

Bathroom group A	Fixture-Units table D.3.5 and note 3	Demand; chart D.2 (gpm)	Pipe size chart D.4 (inches)
1 WC flush tank, CW only	¾ (1×3) = 2.25		
1 lavatory, CW only	¾ (1×1) = .75		
1 bathtub, CW only	¾ (1×2) = 1.50		
Total	4.50	5	¾

Bathroom group B is the same.

Step 12

Size the individual fixture branches in accordance with table D.3.5.

TABLE D.3.5 *Demand weight of fitures in fixture units* [1]

Fixture or group [2]	Occupancy	Type of supply control	Weight in fixture units [3]
Water closet	Public	Flush valve	10
Do	do	Flush tank	5
Pedestal urinal	do	Flush valve	10
Stall or wall urinal	do	do	5
Do	do	Flush tank	3
Lavatory	do	Faucet	2
Bathtub	do	do	4
Shower head	do	Mixing valve	4
Service sink	Office, etc	Faucet	3
Kitchen sink	Hotel or restaurant	do	4
Water closet	Private	Flush valve	6
Do	do	Flush tank	3
Lavatory	do	Faucet	1
Bathtub	do	do	2
Shower head	do	Mixing valve	2
Bathroom group	do	Flush valve for closet	8
Do	do	Flush tank for closet	6
Separate shower	do	Mixing valve	2
Kitchen sink	do	Faucet	2
Laundry trays (1 to 3)	do	do	3
Combination fixture	do	do	3

[1] For supply outlets likely to impose continuous demands, estimate continuous supply separately and add to total demand for fixtures.
[2] For fixtures not listed, weights may be assumed by comparing the fixture to a listed one using water in similar quantities and at similar rates.
[3] The given weights are for total demand. For fixtures with both hot and cold water supplies, the weights for maximum separate demands may be taken as three-fourths the listed demand for supply.

TRAILER COACH PLUMBING STANDARDS

The standards presented in the National Plumbing Code represent the work of the Trailer Coach and Trailer Park Committee of the American Society of Sanitary Engineering.

T.C.1 DEFINITIONS.

T.C.1.2 *Trailer coach* shall mean a self-contained unit designed for the shelter of one or more persons as a residence or for other use as permitted by the administrative authority for the serving of drinks, food, or as a comfort station, and which can readily be moved or transported from one locality to another on its wheels, and which is provided with plumbing facilities.

T.C.1.3 *Sewer connection* is that portion of the drainage piping which extends as a single terminal under the trailer for connecting with the trailer park drainage system.

T.C.1.4 *Water-service connection* is that portion of the water-supply piping which extends as a single terminal under the trailer for connection with the trailer park water-supply system.

NOTE: Fig. 174 shows the location of sewer connection and water-service connection on a trailer coach as required in T.C.1.3 and T.C.1.4. The sewer connection must be on the left side of the trailer, which is the road side. The water connection must be at least 5 feet from the sewer connection, toward or at the rear of the trailer.

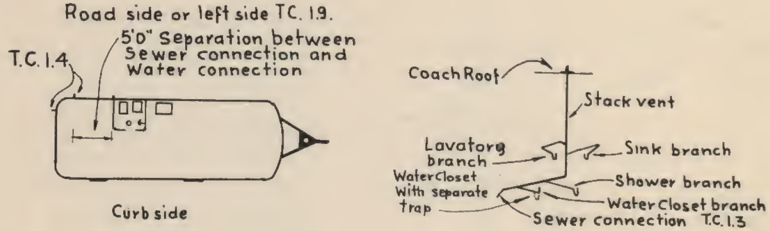


Fig. 174

T.C.2 GENERAL REGULATIONS.

T.C.2.2 *Horizontal drainage piping*—Horizontal drainage piping shall be run in practical alignment at a uniform grade.

NOTE: See Fig. 9—Definitions of horizontal and vertical piping.

T.C.2.3 *Obstruction to flow*—Any fitting, or connection which has an enlargement, chamber, or recess with a ledge, shoulder or reduction of the pipe area, that offers an obstruction to flow through the drain, or any fitting, trap, or connection that offers abnormal obstruction to flow, is prohibited.

T.C.2.4 *Supports*—Piping shall be securely supported to keep it in alignment without undue strains, or stresses, and provisions shall be made for expansion and contraction during travel.

T.C.2.5 *Freezing*—All piping and fixtures which would be subject to freezing temperatures when traveling through cold climates, shall be insulated to preclude the possibility of freezing.

NOTE: Traps exposed under trailer coach, or water piping that might freeze when trailer is stationed or traveling through cold regions must be protected against freezing.

Exposed water piping and fixture traps may be insulated or protected with an electric heating tape. If electric heating tape is used, it should be controlled by a thermostat which turns the electric tape on when the temperature outside drops to near freezing.

T.C.2.7 *Light and ventilation*—Water-closet compartments shall be provided with adequate light and ventilation.

NOTE: This may be done by providing a window or a ventilating outlet through the roof of the trailer.

T.C.2.8 *Ratproofing*—All openings through which piping or other conduits pass through floors or walls shall be properly sealed with permanently attached collars of metal or other material that will prevent the passage of rats or other vermin.

NOTE: Tight-fitting collars should be placed around the pipe where it passes through the floor or ceiling of the coach. A flashing that seals the space between pipe and coach, or a mastic that will be permanently attached, is acceptable.

T.C.2.11 *Sewer connection*—A watertight connection between the trailer-drainage system and the trailer-park sewer connection shall be made by means of a readily removable semirigid or flexible connector acceptable to the administrative authority. [See Trailer Park Standards.]

NOTE: Fig. 175 illustrates a connection at the trailer which should be either at a 45-degree angle or looking downward, so that there will be no kink or sag in the connection. A flexible connection is needed so that it can be adjusted to

the desired distance. A suggested trailer park outlet is shown.

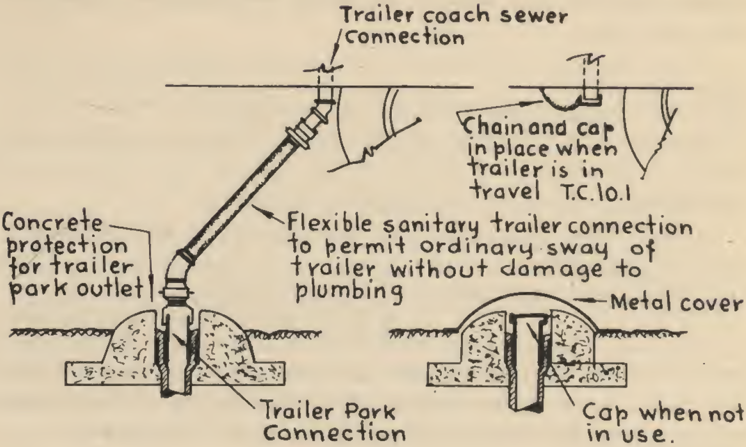


Fig. 175

Fig. 176 shows water connection.

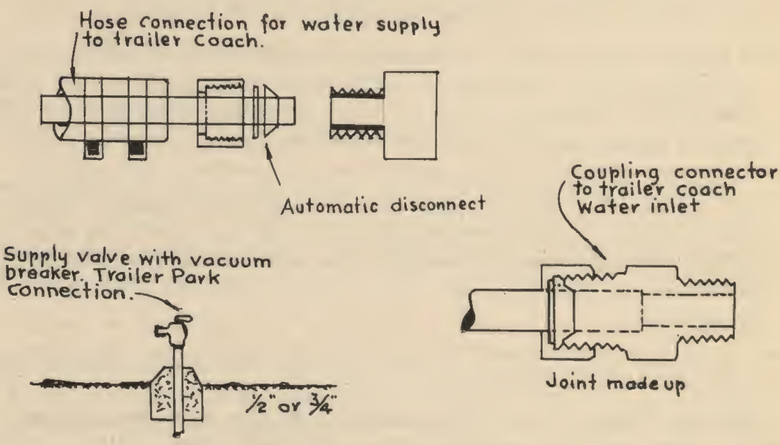


Fig. 176

T.C.2.12 *Location of piping or fixtures*—Piping fixtures, or equipment shall be so located as not to interfere with the normal operation of windows, doors, or other exit openings. Operating devices shall be accessible for repair or servicing.

NOTE: Exits and windows must be kept free for use of the trailer occupants. Plumbing fixtures must be installed so that there is free access for their use and for cleaning and repairing.

T.C.3 MATERIALS.

T.C.3.1 *Drainage and vent systems*—Pipe and fittings for the drainage and vent systems shall be as provided in "Materials—Quality and Weight" of the code and as follows:

(a) Copper tube with sweated joints, type M.

(b) Galvanized steel, galvanized wrought iron, or galvanized ferrous alloy.

(c) Lead pipe not less than ⅛-inch wall thickness.

(d) Fittings for the drainage system shall be American National Taper Threads, recessed type. Vent fittings may be galvanized, malleable, or cast iron. If lead is used, all joints shall be wiped. Wiped joints shall have an exposed surface on each side of the joint not less than ¾-inch and at least as thick as the material being jointed.

T.C.3.2 *Water piping*—Water piping shall be brass, copper, wrought iron, open-hearth iron, steel or copper tubing, type L, with appropriate approved fittings. All ferrous pipe and fittings shall be galvanized.

NOTE: Light materials are necessary for a trailer coach, but they must withstand shock and vibration during travel. The water piping must be corrosion-resistant because it is not possible to predict what kind of water will be used.

T.C.4 FIXTURES.

T.C.4.1 *Quality of fixtures*—All plumbing fixtures shall be made of approved materials with smooth, impervious surface.

T.C.4.2. *Trailer-coach fixtures*—Plumbing fixtures installed in the trailer shall be of materials that will withstand road shock and be so attached to the structure of the trailer as to be resistant to vibration or settling.

T.C.4.3 *Resistance to shock*—Resistance to shock shall be determined by tests over a period of actual use of 1 year or by equivalent simulated laboratory tests.

T.C.4.4 *Fixture traps*—Each plumbing fixture shall be provided with a trap containing not less than a 2-inch water seal.

T.C.4.5 *Location of traps*—Traps shall be so located as to preclude the possibility of trap-seal loss during transportation or ordinary use.

T.C.4.6 *Water closets for trailers*—

(a) Water closets shall be constructed of such durable materials as to be transported in trailers over the highways without injury or impairing their capacity to operate.

(b) Water closets shall not permit the spillage of trap-seal contents during transit and shall perform in a sanitary manner.

(c) It should not be possible to flush a water closet except when trailer is connected at a trailer camp to a water supply and sewage-disposal system.

(d) Each water closet shall be provided with approved backflow or vacuum breaker device to prevent contamination of the potable-water system.

(e) Water closets shall be provided with a water supply adequate to thoroughly cleanse the interior of the water closet when the valve is operated.

NOTE: The most commonly used water closets in a trailer coach are the grinder, the marine, and the hopper types. Tests relative to all these types of water closets are in progress at the National Bureau of Standards.

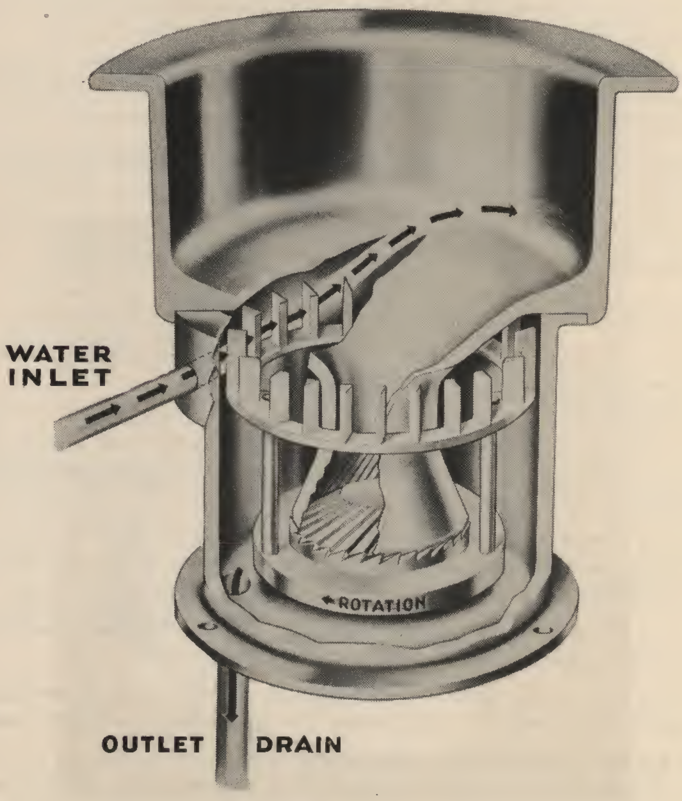


Fig. 177

Fig. 177 illustrates a grinder-type water closet, operated by water pressure.

Fig. 178 shows a hopper-type closet.

Fig. 179 shows a recently developed trailer coach water closet combining the features of a regular bowl integral trap and an electric grinder operation.

Fig. 178

Fig. 179

Fig. 180 illustrates a commonly used valve for flushing trailer coach water closets. This valve incorporates anti-backflow features. This valve can be used safely on other supply piping to prevent backflow of polluted water into the potable water supply system.

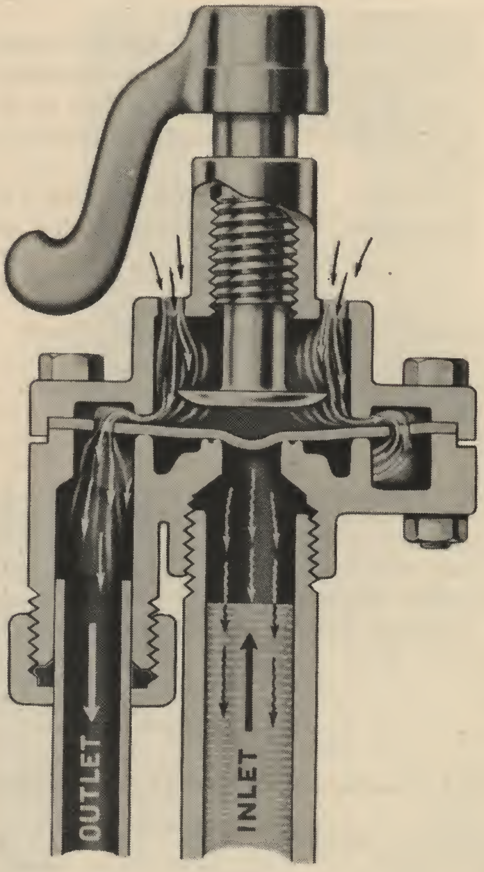


Fig. 180

NOTE: The basis of selection of the proper type of piping for drainage and water supply for a trailer coach is somewhat different from that for a house. The location of the house is permanent and the selection of piping should be based on local conditions and practices. A trailer coach may

be moved from one part of the country to another and be subjected to aggressive waters as well as non-aggressive waters. Therefore, the selection of piping for a trailer should be on the basis of the life expectancy of the coach itself, and the piping should be so arranged as to be readily replaceable.

T.C.5 DRAINAGE PIPING.

T.C.5.1 *Installation*—Horizontal piping shall be installed at a uniform slope and in no case less than ⅛-inch per foot slope.

T.C.5.2 *The size of soil and waste piping* shall be in accordance with table T.C.5.3, using table T.C.5.4 when necessary to determine fixture-unit ratings.

Based on the values so established in table T.C.5.4, pipe sizes have been established for trailer coaches as given in table T.C.5.3.

TABLE T.C.5.3—SIZE OF MAIN SOIL STACK

Fixture connection	*Minimum size through roof (Inches)*
More than 6 fixture units connected to stack	3
6 fixture units or less connected to stack	2
Lavatory branch waste and trap	1¼
Sink branch waste and trap	1½
Shower branch waste and trap	1½
Bath branch waste and trap	1½
Water closet branch waste:	
4-unit type	3
2-unit type	1½

TABLE T.C.5.4—TRAILER FIXTURE UNIT RATINGS

Fixtures	*Fixture-units*
Water closet with 3-inch integral traps	4
Water closet with separate traps	3
Water closet, grinder type, with 1½-inch trap	2
Lavatory with less than 1⅛-inch outlet	1
Sink with less than 1⅛-inch outlet	1
Sink with larger outlets	2
Shower with less than 2-inch outlet	2
Shower with 2-inch outlet	3
Bathtub with less than 2-inch outlet	2

NOTE: Fixture unit ratings for trailer coaches differ from standard-type fixtures because of the smaller-size fixture and the lower rates of flow. Standard-type water closets have been rated the same as for a house; however, trailer coaches are most often fitted with special-type water closets which prevent trap-seal spillage during transportation. The most frequent types are the grinder type, the hopper type, and the marine type.

The rating of the various types has been established by preliminary flow test, and table T.C.5.4 establishes these values.

T.C.5.6 *Group venting*—A group of fixtures consisting of one water closet, or shower or bathtub, one lavatory, and a kitchen sink may be installed without individual fixture vents and as a stack-vented group. Each fixture branch shall be installed within the limits as given in table T.C.5.7.

TABLE T.C.5.7
MAXIMUM LENGTH OF UNVENTED BRANCH WASTE

Size of waste pipe (inches)	*Permissible length* *Ft.*	*In.*	*Size of waste pipe (inches)*	*Permissible length* *Ft.*	*In.*
3	6	0	1½	4	6
2	5	0	1¼	4	6

NOTE: Piping arrangement, common to many trailers.

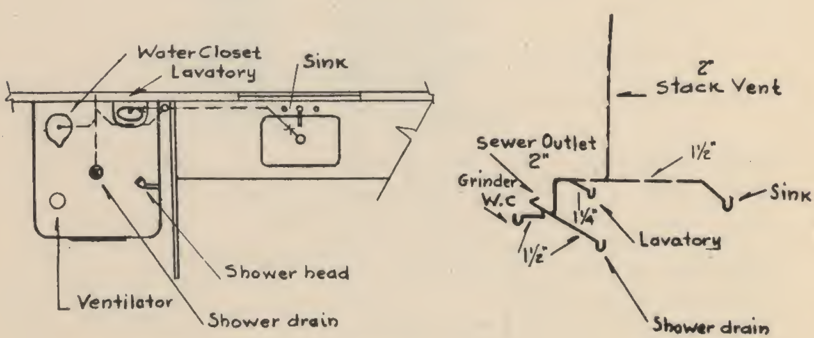


Fig. 181

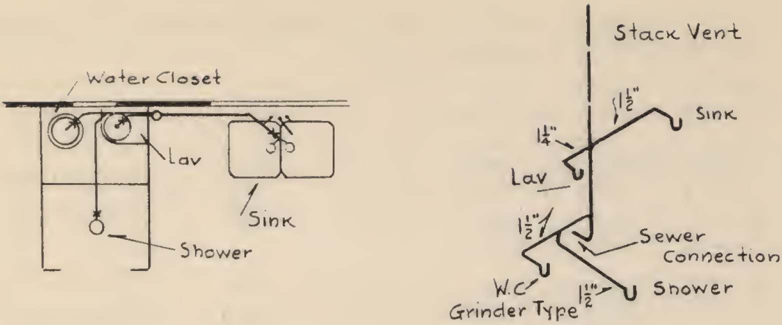


Fig. 182

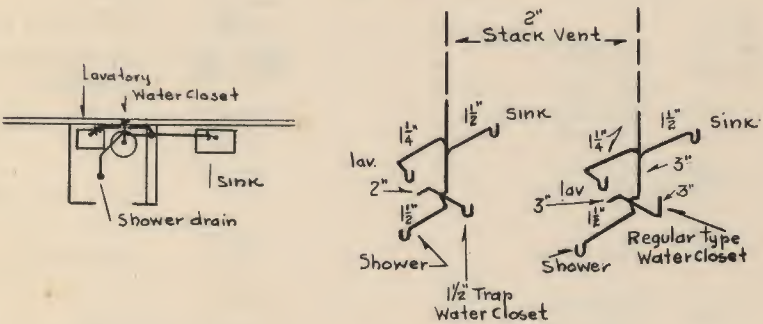


Fig. 183

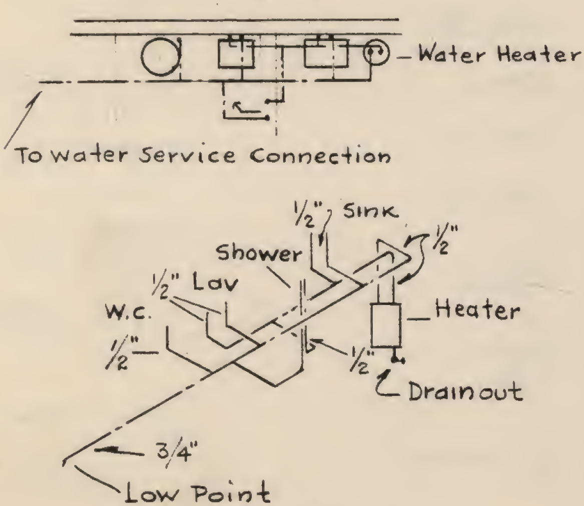
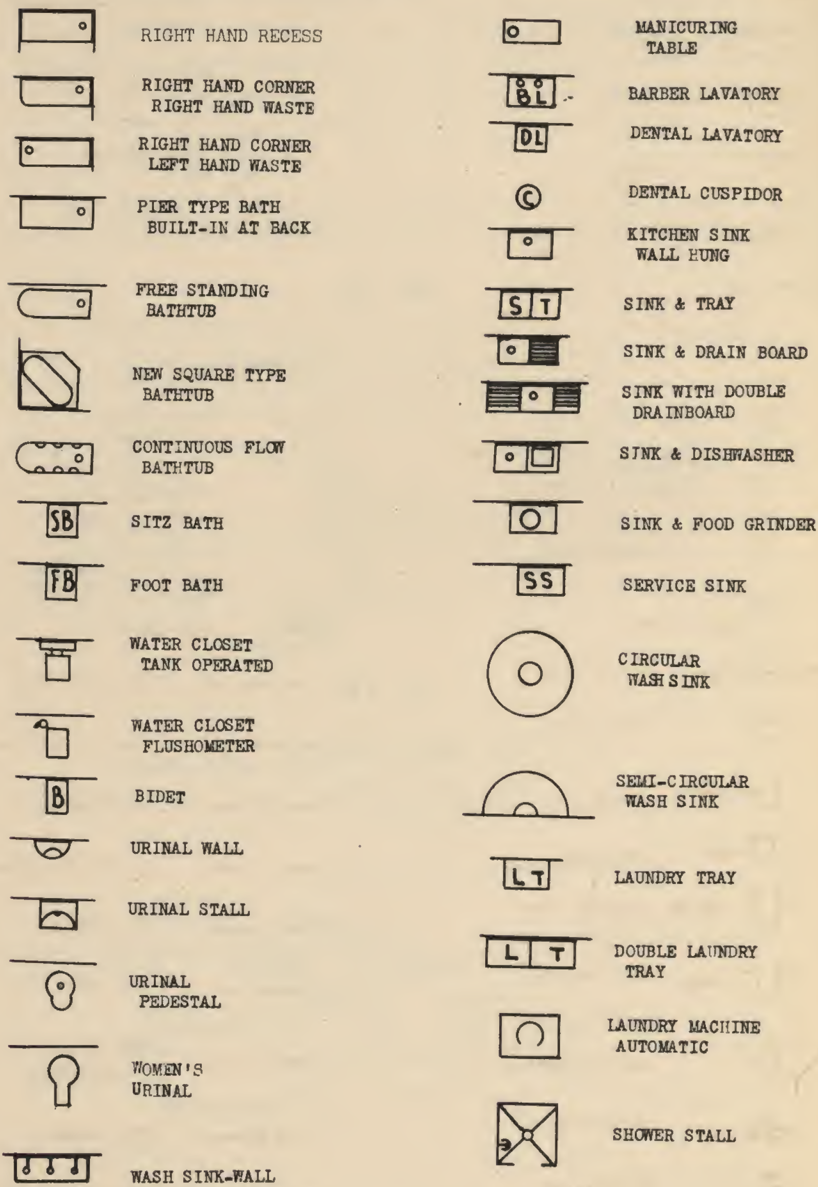


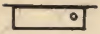
Fig. 184

SYMBOLS

The following symbols for plumbing fixtures and piping are those most commonly used.



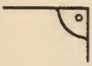

WASH SINK


URINAL TROUGH


LAVATORY
WALL HUNG


LAVATORY
PEDESTAL OR LEG


LAVATORY
SPACE SAVER


LAVATORY
CORNER

DRAIN

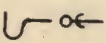

GREASE INTERCEPTOR

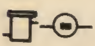

OIL SEPARATOR

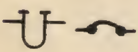

CLEANOUT

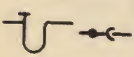

GANG SHOWER


SHOWER HEAD


"P" TRAP


DRUM TRAP


RUNNING TRAP
2-C.O.

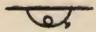

RUNNING TRAP
1-C.O.


CHECK VALVE


GATE VALVE

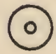

GLOBE VALVE


DRINKING FOUNTAIN
PEDESTAL


DRINKING FOUNTAIN
WALL


DRINKING FOUNTAIN
COOLER

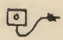

RANGE BOILER


AUTOMATIC WATER
HEATER


WATER METER


HOSE BIBB

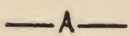

FROST PROOF
HOSE BIBB


FLOOR DRAIN WITH
BACKWATER VALVE

ROOF DRAIN

DRAINAGE PIPE

VENT PIPE



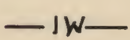
ACID WASTES

INDIRECT WASTES

COLD WATER

HOT WATER

HOT WATER
CIRCULATION



ICE WATER

SUB-SURFACE DRAIN

 UNION

 FLANGE

 PRESSURE REDUCING VALVE

 PRESSURE RELIEF VALVE

 TEMPERATURE RELIEF VALVE

 COMBINATION T & P VALVE

— F — FIRE LINE

— S — STORM DRAIN

— G — GAS PIPING

COLOR IDENTIFICATION OF PIPING

POTABLE WATER ——— GREEN, BLUE, WHITE

NONPOTABLE WATER ——— YELLOW, ORANGE

FIRE PROTECTION ——— RED.

SPECIAL PIPING ——— PURPLE, BLACK, BROWN

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INDEX TO ILLUSTRATIONS

INDEX

This index can also serve as an index to the National Plumbing Code.